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Mr. Schwab on Education.

An address to some "East Side" boys by the president of the United States Steel Corporation has attracted a good deal of attention. In it he told how few of the leading men of the day were college-bred men and gave it as his opinion that college education has small value, so far as "getting on in the world" is concerned.

In no report of the address that we have seen has it been made clear just what Mr. Schwab means by "college education." In the old days that term signified, and to many minds it still signifies, the older so-called liberal education, founded on the classics, philosophy, mathematics, etc. If Mr. Schwab attaches this meaning to the term there can be little doubt that he is right and the apostles of that education can hardly quarrel with him. They would in fact be the first to deny that there can be any connection with the study of the classics and what they call "mere money getting," and they would look upon the opposite claim as a very sordid view of the real meaning of education. Among others it is, we think, generally accepted that in commercial and industrial life the older education has little or no value in the sense here referred to.

There is to-day, however, a new "college education" which has arisen to prominence in a single generation, and whose aim, so far as the individual is concerned, is to fit him for successfully following a vocation. As we have said, it is not clear whether Mr. Schwab includes this education in his remarks or not. He certainly might do so, and he might very easily point out plenty of instances of men without it who are by long odds leaders in the industrial world, who in fact occupy leading positions over large numbers of men who have this education. The great corporation of which he is president employs many such technically educated men, and its affairs could not, in fact, be conducted without them. Many of them receive very comfortable salaries, not large ones in comparison with his own, but large ones to most people, and probably large ones in comparison with Mr. Schwab's own expectations not many years ago.

Shall the fact that Mr. Schwab has passed these men in the race of life and that their services are at his command be held to show that a man is more likely to succeed without technical education than with it? We think not. The true comparison is not between different men but between the achievements possible by the same men with and without such education.

The talents of men are very diverse, and different positions require different kinds of talent. There are doubtless many men —of whom Mr. Schwab is one—who are superior to all formal education, and there are likewise many positions in the industrial world in which formal education, technical or other, gives little help. The great prizes of life are largely of this kind. When it comes to dealing with men, or, in other words, when it comes to positions in which the leading requirements are executive capacity and broad, sound judgment, technical education is of small and perhaps no value; but when it comes to dealing with things, the reverse is true. Here knowledge of the laws of nature, of what has been done and of what can be done is a prime requisite. For such work the man without this knowledge is seriously handicapped.

Many men acquire this knowledge by a process of self-education, but that systematic instruction is other than a help to men who are adapted to technical work and who must make a success at such work, if they are to be successful at all, cannot, in this day and age, be successfully maintained. The fact that education is of small or no help in a career or a position like Mr. Schwab's has no bearing upon the question of its helpfulness in other careers. That there are large fields of usefulness, of profit and of honor open to those who have been denied the privilege of an education, and that these fields include the very greatest prizes of life, is fortunately true. Mr. Schwab did an undoubted service to his audience in pointing out the fact, but it would, we think, have been in better taste and in better accord with the facts if he had put it this way. The undoubted truth of this statement has no bearing counter to the claims of education, and we are very loth to believe that Mr. Schwab thinks it has.

Because the few great prizes of life are within the reach of those without such education, and because the uneducated largely outnumber the educated, it will doubtless always be true that the majority of such positions will be held by the uneducated. In other words, education must always hold, as it always has held, a position inferior to natural talent and force of character. This is as true of the engineer as of his superior officer. The education must have a suitable foundation of natural talent, and just as some are superior, so also some are inferior to it. To both classes alike it is largely useless—to one because it does not need it, and to the other because it cannot use it.

The real test of personal success is not, however, the position one holds but the satisfaction one finds in his work and its results. In this respect the technically educated man, if his education is based on a suitable natural foundation, is especially fortunate. Nothing is more common than to find thoroughly successful men in business life who obtain little satisfaction from life or from their achievements. This we believe is conspicuously not true of engineers. There is a degree of satisfaction in dealing with material things and in bending the forces of nature to one's will which comes to the engineer in greater degree than to anyone else. Whatever may be the salary and whatever the degree of deference accorded to his superior, there is no ground for envy here, nor we believe is envy often felt. Engineers as a class are, we believe, better satisfied with their work than are the fellowers of any other vocation whatever.

Ten Months' Exports to Russia.

Manufacturers whose business in Russia has been injured by the sugar decision and its consequences will derive no comfort whatever from the statistics recently issued

from Washington showing that our exports to Russia have increased during the past ten months. A machinery builder, for instance, whose Russian business has been ruined by this utterly useless and absurd action will hardly be able to see how he is compensated for his loss by the alleged fact that exports in other lines may have increased enough to compensate the falling off in his own line so far as the total volume of exports is concerned. What this country has done in the way of exports to Russia within ten months has nothing whatever to do with the question as to whether American machinery builders doing business in Russia have been injured by action resulting in the imposition by Russia of import duties on American machinery much higher than are imposed upon machinery entering Russia from Belgium, Germany or England. Such statistics may deceive some people, as they are evidently intended to do, but not those who are well informed or who look at these matters from a business standpoint.

Not Only a Machinist but a "Westerner."

Workingmen who may have been offended by the "Century" stories of "The Bread Winners" order may feel comforted possibly by looking through the story in the June number entitled "Wanted, a Hero." It is an exceedingly silly and tiresome story about a girl who worshipped a college football captain and became engaged to him. But having his way to make in this world he sought to become a mining engineer and the dear creature visited him in a machine shop where he was working. Then he used bad grammar, though a Yale graduate, simply because "Century Magazine" workingmen must always speak bad grammar and be otherwise uncouth. Not only that, but she realized then for the first time that he was after all nothing but a "Westerner" and so she went to New York, broke off the engagement and married a man who never went inside a machine shop (even to learn to be a mining engineer) and who, above all things, was not a "Westerner." "And they lived happy ever after."

Action of the National Metal Trades Association.

At a special meeting of the National Metal Trades Association held in New York on the 11th inst., a declaration was unanimously adopted which, after calling attention to the fact that an agreement was in force with the International Association of Machinists at the time the strike was ordered, says:

"James O'Connell, president of the International Association of Machinists, without attempt to arbitrate, officially called a strike against shops of our members which did not accede to certain arbitrary demands by a specified date. We declare that we urged President O'Connell to arbitrate any and all matters of dispute and reiterated our willingness to abide by arbitration and used our best efforts to avoid a strike. We deplore the fact that the general officers of the International Association of Machinists have seen fit to violate their contract and throw dishonor on the association for which they stand and so make it impossible for our association to place any faith in the responsibility of the machinists' union.

"We declare that the machinists' union has, through its National and local officers, broken faith with us and proved themselves to be an irresponsible body, with whom we can make no contracts that will be binding upon them. We recognize the right of any man to belong or not to any religious, political or economic sect, as he may see fit; also his right to leave our employment at his free will, and his right to sell his labor at the best price he can command. We maintain our inalienable rights to employ a man whether he belongs or not to any organization and at wages mutually satisfactory, and also to discharge him at our discretion. We insist that the management of a shop is in the hands of the employer and is not to be interfered with by the employee.

"We insist that a fair day's work shall be given for a fair day's wage, and we will give a fair day's wage for a fair day's work. We believe that a shortening of the working hours or an increase of wages can only be brought about by the hearty co-operation of employer and employee in advancing and not in retarding production and by introducing and not fighting improved methods. We decry strikes and lockouts as unbusinesslike and unnecessary and believe that all disagreements can be adjusted by other means, and the condition of employer and employee both benefited more by harmonious progress than by strife and discord."

The Declaration of Principles issued by the Administrative Council, May 28, was also adopted. The resolutions and declaration being as follows:

RESOLUTION ADOPTED BY THE ADMINISTRATIVE COUNCIL AT CHICAGO, MAY 28, 1901.

Whereas, The National Metal Trades Association and the International Association of Machinists formally entered into an Agreement on May 18, 1900, for the express purpose of avoiding strikes and lockouts by arbitrating all disputes between employers and employees,

And whereas, It was specifically agreed that pending arbitration, there should be no strikes or lockouts,

And whereas, In direct violation of that Agreement, the I. A. of M. has refused arbitration and has officially ordered and instituted strikes in many shops of the members of the N. M. T. A.,

Be It Resolved, By the Administrative Council in session in Chicago on this, the twenty-eighth day of May, 1901, that the International Association of Machinists has wilfully violated its agreement of May 18, 1900, and having made the same null and void, the Agreement is no longer binding on the National Metal Trades Association.

DECLARATION OF PRINCIPLES ADOPTED BY THE ADMINISTRATIVE COUNCIL, AT CHICAGO, MAY 29, 1901.

We, the members of the National Metal Trades Association, declare the following to be our principles, which shall govern us in our relations with our employees.

1. Since we, as employers, are responsible for the work turned out by our workmen, we must, therefore, have full discretion to designate the men we consider competent to perform the work and to determine the conditions under which that work shall be prosecuted. The question of the competency of the men being determined solely by us, and while disavowing any intention to interfere with the proper functions of labor organizations, we will not admit of any interference with the management of our business.

2. Disapproving absolutely of strikes and lockouts, the members of this Association will not arbitrate any question with men on strike. Neither will this association countenance a lockout on any arbitrable question unless arbitration has failed.

3. Employment.—No discrimination will be made against any man because of his membership in any society or organization. Every workman who elects to work in a shop will be required to work peacably and harmoniously with all his fellow employees.

4. Apprentices, Helpers and Handymen.—The number of apprentices, helpers and handymen to be employed will be determined solely by the employer.

5. Methods and Wages.—Employers shall be free to employ their work-people at wages mutually satisfactory. We will not permit employees to place any restriction on the management, methods or production of our shops, and will require a fair day's work for a fair day's pay.

Employees will be paid by the hourly rate, by premium system, piece work or contract, as the employer may elect.

6. It is the privilege of the employee to leave our employ whenever he sees fit and it is the privilege of the employer to discharge any workman when he sees fit.

7. The above principles being absolutely essential to the successful conduct of our business, they are not subject to arbitration.

In case of disagreement concerning matters not covered by the foregoing declaration, we advise our members to meet their employees, either individually or collectively, and endeavor to adjust the difficulty on a fair and equitable basis. In case of inability to reach a satisfactory adjustment we advise that they submit the question to

arbitration by a board composed of six persons, three to be chosen by the employer and three to be chosen by the employee or employees. In order to receive the benefits of arbitration, the employee or employees must continue in the service and under the orders of the employer pending a decision.

In case any member refuses to comply with this recommendation, he shall be denied the support of this Association unless it shall approve the action of said member.

8. Hours and Wages.—Hours and wages being governed by local conditions, shall be arranged by the local associations in each district.

In the operation of piece work, premium plan or contract system now in force or to be extended or established in the future, this association will not countenance any conditions of wage which are not just, or which will not allow a workman of average efficiency to earn at least a fair wage.

Explosions of Castings.

The Special Inspector of Factories, Bengal, India, gives the following list of accidents, all of the same type, which have come to his knowledge. We have occasionally given the particulars of cases of this character, but they would seem to be of more frequent occurrence than we had supposed:

(1) The first one occurred in the workshop of the India General Steam Navigation Company at Kidderpore. A large marine piston was clamped to an iron bed-plate for the purpose of removing the piston-rod by expanding the piston. A fire was lighted below the piston, which shortly after burst with terrific force, killing one man and injuring several.

(2) A hollow pump-plunger that had been lying on the scrap heap of a jute mill was thrown into the cupola to melt. This shortly after burst, and two men engaged in feeding the cupola were badly burnt.

(3) A pump-plunger rod was bent in the Cawnpore Ice Works. This was placed on the fire attached to the plunger to straighten. The plunger burst and killed one man.

(4) A pump-plunger was heated for a similar purpose in the Jhansi works of the Indian Midland Railway, and it burst. One man was so seriously injured that he eventually died.

(5) On two occasions hollow sugar-mill rollers were placed on the fire to remove the worn or broken steel spindles by expansion. These (on two separate occasions) burst, a portion going through the corrugated roof, but fortunately no one was hit by the flying portions.

"I feel sure," says the inspector, "that if these accidents were generally known to the supervising staff in shops, they would naturally have taken the precaution of drilling a small hole for the escape of steam, as the expense and time incurred in doing so would be trifling. It is evident that moisture finds its way into these hollow castings whether working under pressure or not."

Elsewhere in this issue there is published by authority of the British Embassy at Washington notice of prizes to be awarded for self-propelled wagons suitable for military uses. The prizes range from $500 to $2,500, and the conditions are fully stated. The results will be watched with much interest, and it is of course apparent that the successful competitor will be in the way of securing a very large contract if a suitable wagon is brought out.

We understand that the Jones & Lamson Company, of Springfield, Vt., reduced their working day to nine hours without reduction of pay some time previous to April 20, though no demands were made upon them by the men, and so far as the company knew none were to be made.

Commercial Review.

New York, Monday, June 17.

THE MACHINERY MARKET.

For another week the tool market has been subjected to the unfortunate labor conditions from whose grasp no relief in the near future is clearly visible. But as yet the effects upon distribution continue to be less marked than those upon production. That is, the dealers in town have thus far not experienced a falling off in their trade in the same proportion to which, it may be estimated, the output of work is curtailed in the tool manufactories. On the contrary, demand for tools is pretty good. This would seem to indicate that the machinists employed in building tools have gone out with more nearly uniformity than those engaged in other lines of machine work.

Instances of inability to make seasonable deliveries are growing more numerous as time goes by. Dealers' and manufacturers' stocks are still sufficing to a considerable extent for current needs and there is no general sweeping of wareroom floors, but inconveniences are being encountered in particular sorts and sizes of tools here and there. The difficulty is greatest with heavy tools, which, being a "built" rather than a "manufactured" article, are most easily set back in delivery and which have been caught squarely in the current of the strike. It is not altogether the large tools with which there is trouble, however. One local agent, for example, is badly embarrassed about obtaining automatic screw machines from the company he represents. Of course deliveries under the present circumstances are not a question of certain weeks and months as they are where the market is simply overdrawn upon by rising demand, but are rather a question of where you can find a tool ready for you or where you encounter a maker who is all at sea with his men and cannot promise it at any particular date. Although one need hardly expect such a dearth of tools as was occasioned from quite another cause in the flush year 1899 it looks quite as if a prolongation of the strike will bring to those manufacturers whose works are running the similitude of a little boom.

A grain of philosophical comfort may be found in the embarrassment that arises where the supply of tools is partially cut off, since it goes toward proving that the normal production of tools is not as greatly in excess of the normal demand as has sometimes been feared. It confirms the inference that has been drawn from the firmness with which the American tool industry sustained the recent blow to its foreign trade and indicates that the money spent upon American tool-building shops in the last few years was not an ill-thought investment.

While the strike in their own works is a subject which to-day seems to touch machinery men the most nearly, another matter is developing which is likely to prove of still greater importance to the metal trades in common. The tacit challenge to competition thrown down by the United States Steel Corporation has been taken up and the struggle for supremacy or independence in the iron and steel trade seems close upon us. Established companies are hastening to increase their capital and their plants, while new ones are entering the field in great numbers. The value of the plants already existing outside of the United States Steel Corporation would be a surprise to such persons as assume the trust to have swept the table clean and some of these independent companies are very powerful. One of the strongest is Jones & Laughlins, Ltd., which controls its ore mines and which has entered upon large extensions. The Cambria Steel and Pennsylvania Steel have made large increases of stock; the Tennessee Coal, Iron & Railroad and the Colorado Fuel & Iron have each arranged to issue $15,000,000 new bonds. Since the United States Steel Corporation was organized some fifty companies, each with a capital from $50,000 upward, including machinery concerns, etc., have entered the field. The policy of the United States Steel Corporation is manifestly to secure control of its chief competitors, and not only the Bethlehem but the Pennsylvania Steel Company seems virtually to have been brought into line. Rumors tending in the same direction are rife in regard to the others. Now, if the trust intends to keep on indefinitely buying up its competitors, of course we will all go into the business of organizing steel companies to sell out to Mr. Morgan and his friends. But competition is hydra-headed, so it is likely that the Morgan crowd will sooner or later tire of the game. For the present a boom of new construction is on, let the future bring what it may.

Of the prospects of the steel industry a man in the small tool trade with whom the writer was talking the other day, reasons from his own experience. Some years ago, in a time of exceptional demand, he had a call for foot-power engine lathes selling at a hundred and some odd dollars, on which he was unable to obtain satisfactory deliveries from the manufacturers. He proposed to a machine shop in the vicinity to build some for him especially, offering to pay for the patterns and after some little hesitation the shop consented. This line of lathes went off like hot cakes until he had as many as a hundred of them coming through. After a while, however, the exceptional activity of the market subsided and then buyers returned to the old makes. He argues that likewise it will be a case of survival of the fittest in the steel industry and that when dull times come the weaker concerns will drop out, leaving the strong alone in the field.

The Anchor Machine Company, Pittsburgh, Pa., has placed an order with the U. Baird Machinery Company, Pittsburgh, for a large amount of special machinery which will be installed in a new addition to be built to the Anchor plant in the very near future. The company will manufacture gas engines of the "Modern" type, now being made in Buffalo, N. Y.

The awards for the government arsenal at Rock Island are coming along slowly. Among the last is an award to the Toledo Machine & Tool Company, Toledo, Ohio, for a number of extremely heavy punch presses.

A formal protest has been addressed to the Chief of the Bureau of Construction and Repair, U. S. Navy, by the president of the Abendroth & Root Mfg. Company, against the award to the Babcock & Wilcox Company, of a contract for three water-tube boilers for the Washington Navy Yard, based on bids opened May 7. The offer covering the Babcock & Wilcox boilers was $13,023, while the price named by the United Engineering Company, which bid for the Abendroth & Root Company, was $11,324. The complaint alleges chronic favoritism to boilers of the B. & W. type and cites a contract for the Brooklyn Navy Yard within the past year as an instance. The specification and plans in that case, the letter states, "were drawn in such a manner as to practically preclude the possibility of any boiler maker securing the contract except a builder of the Babcock & Wilcox Company's type." The protestant threatens to bring the matter before Congress.

The Imperial High Director of Marine, of Germany, and Professor E. von Halle, of Berlin, are making a circuit of all the shipyards in the country with the view of ascertaining the best methods of construction. They have already visited the Cramps, the New York Shipbuilding Company, the Newport News Shipbuilding Company, and the yards at Cleveland, Chicago and New London. It is believed that their next visit is to Bath and completes their circuit of yards. They are showing interest in pneumatic shell and deck riveters and the larger sizes of drills

Chinese imports of machinery from the United States in 1900, by the estimate of Consul-General Goodenough, amounted to $270,000. Several large manufactories have been equipped with American machinery; notably a 300-barrel flour mill in Shanghai, which has been so successful that work to convert it into a 1,200-barrel mill has been begun.

Korean trade statistics show that machinery amounting to $37,890 was imported in 1900. The estimated proportion of this coming from America is $29,880. Of mining supplies $158,208 worth were imported, the estimated proportion coming from this country being $149,400.

CHICAGO MACHINERY MARKET.

In volume the Western trade in machinists' supplies is making a good average showing. It is less than in May but somewhat above the business of a year ago, at least it is so reported by a number of factors. Statements are not uniform, but are not very far apart. The general verdict is that trade is at least fair and with some people it is described as quite active.

A variety of causes are creating revolutions and the situation is not quite what it was with anyone two years ago, thus making an estimate difficult. There are revolutions in the manner of doing business, revolutions in the class of buyers, revolutions in the size and number of orders. It is the house that is adjusting itself to the new conditions that fares best. The numerous combinations of manufacturers have lessened the number of buyers, given ten times the usual trade to one producer and taken away trade from nine others, shrinking quite often the influence of the middleman and creating a more direct communication between manufacturer and consumer, and not infrequently narrowing margins through the competition for the combined business. But there is expansion of trade in so many new directions that this massing of some business in few hands is not without its ample compensations. Except in the more conservative and staple lines of supplies, it is not uncommon to find that a supply house or the manufacturer of specialties is getting into a trade so new that the books of several years ago would seem strange when compared with present accounts.

Western manufacturers are now ordering material and supplies for the second half of the year with great freedom. Hence markets extending from pig iron and steel bars to files and emery wheels are showing gains, where purchases are made on the contract plan. The crop outlook is well enough assured to induce active preparations for next season's production, beginning in midsummer, among manufacturers whose products go to the farm. But in the equipment of shops the present condition of trade is not so brisk as it was a month ago. This is all the more noticeable, for the reason that in May there were many changes in location among the smaller manufacturers and many extensions of plant capacity. Alterations and removals have been completed, and current trade runs mainly to scant repair work and to the fitting out of a few new plants.

The Saginaw Manufacturing Company reports that the demand for pulleys has been excellent since last December, running along with little change in volume since that month.

The Crosby Steam Gauge and Valve Company has a steady demand for its products. The capacity of its factories has been increased within the past year but it is busy and is behind in its orders.

The Winslow Elevator & Machine Company say that inquiries for freight and passenger elevators, which may be considered an index of construction work, are now twice as many as they were two months or a year ago. The outlook for business is flattering.

Quotations.

NEW YORK, Monday, June 17

Pennsylvania Foundry Pig Irons, Jersey City delivery, good brands:

No. 1 X	$15 15 @ 15 75
No. 2 X	14 65 @ 15 15
No. 2 plain	14 15 @ 14 65
Gray forge	13 75 @ 14 50

Alabama Pig, New York delivery:

No. 1 foundry, or soft	15 25 @ 15 50
No. 2 foundry, or soft	14 75 @ 15 00
No. 3 foundry	14 25 @ 14 50
Foundry forge, or No. 4	13 75 @ 14 00

Bar Iron—Base sizes—Refined brands, mill prices on dock, 1.58 @ 1.65c.; from store, 1.80 @ 1.90c. Some sellers have raised their prices to the new minimum from store, 1.85c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 1.90 @ 2.00c.

Cold Rolled Steel Shafting—Base sizes—From store, 2½ @ 2¾c.

Copper in carload lots—Lake Superior ingot, 17c.; electrolytic, 16⅝c.; casting, 16½ @ 16⅝c.

Pig Tin—28 @ 28⅜c., for 5 and 10-ton lots, f. o. b.

Lead—For wholesale lots, 4⅜c., with .02½ @ .05c. extra for carloads.

Spelter—3.95 @ 4c., New York.

Antimony—Cookson's, 10⅜ @ 10½c.; Hallett's and U. S., 8¾c.; Hungarian and Italian, 8⅝c.

Lard Oil—Prime City in jobbing lots, 68 @ 70c.

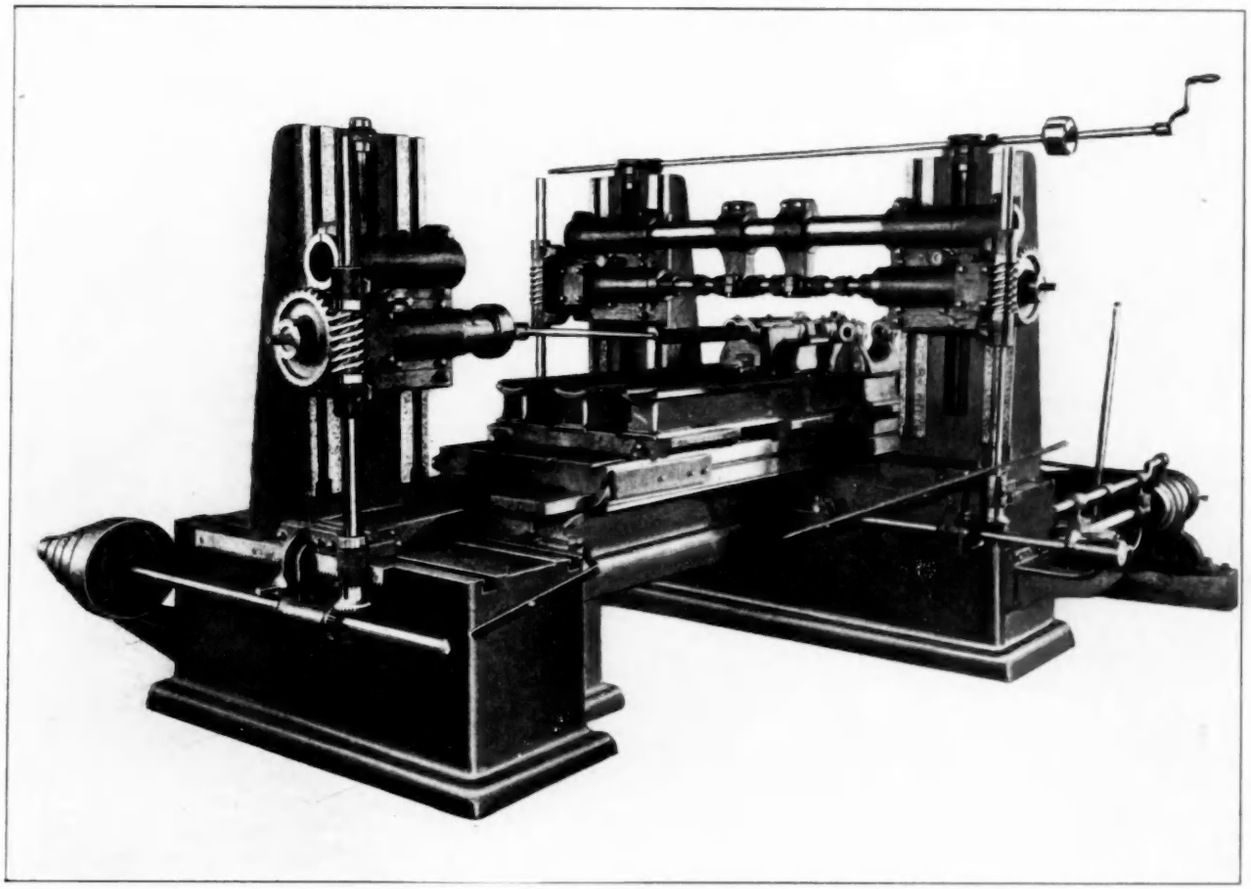
A Special Milling and Boring Machine for Small Lathe Beds.

The half-tone shows an interesting special machine, such as is warranted and frequently adopted in establishments where special machines are turned out in sufficient numbers. The arrangement here shown was designed and built by the Automatic Machine Company, of Greenfield, Mass. It is, as will be seen, a combined milling and boring machine, and is shown here in the act of machining, at one setting, three speed lathe beds, 11 inches by 5 feet. The headstocks of these lathes are cast on the beds, and all the machining required on the entire casting, except a little drilling, is done on this machine and in short time. The beds are first set, three at a time, on fixtures on the platen, which raise them sufficiently to clear the headstocks and which locate them correctly and hold them securely. The entire bottom surface of each bed and the front edge of the base of each are then milled all at once. Only one cut is required for this operation, and the time required is ninety minutes. The gang of cutters milled sixty-three of these beds before regrinding. All of the batch of lathe beds under way are of course put through this operation before the next setting.

The next work is the milling of the tops of the beds. Another set of fixtures or jigs are bolted to the platen and on these the beds are located by the previous milling without any trying or correcting. The horizontal milling spindle, seen in the half-tone raised up out of the way, carries a gang of cutters which go over at once the entire outline requiring milling on the three beds, a bold "V" on each side with the horizontal and vertical portions. Two cuts are taken over the top, a roughing and a finishing cut, the time for the entire operation being 100 minutes.

The half-tone shows the machine engaged in the third operation, that of boring the headstock. This is done separately on each bed. A rigid guide for the boring bar, of sufficient length to ensure its accuracy, is bolted to the top of the bed, and the boring bar is driven by the horizontal spindle in front, with universal joints at each end of the driving rod, so that it is not essential for this driving spindle to be accurately in line with the other part of the machine. The bar does not move horizontally, the work being fed over it by the movement of the platen, as in the milling. The time for setting the fixture and boring is 40 minutes.

The general features of the machine require little explanation or comment. The use of the worm drive makes the machine at once powerful and simple in operation. The travel of the platen is 6 feet. The vertical movement of the spindle carriers is 26 inches, operated by power. The lateral movement of the boring head is 30 inches. The distance between the uprights of the miller is 40 inches. The weight of the entire machine is about 10,000 pounds. Automatic stops as well as the automatic feeds are provided.



A SPECIAL MILLING AND BORING MACHINE.

Testing Ram Pressures in Presses.

BY OBERLIN SMITH.

An inspection of the catalogs of the makers of presses for shearing, punching, cutting, bending, forming, drawing, embossing and coining metals and other materials will show that the capacity of such machines is rarely given in terms of ram pressure. It is therefore difficult to make comparison in this respect between the various machines of the same or of different makes.

In designing and marketing this class of tools, I have long felt the need of some accurate specification of the kind mentioned, and I have for several years been getting the approximate pressures attained in various machines by the crude method of ascertaining how big a hole they would punch in a given thickness of iron. The data for my calculations in such cases were

obtained chiefly from various text-books which gave the results of punching and shearing experiments, but which, like many other records of the kind, seemed to indulge in considerable variation of statement, both in premises and conclusions.

In recent years, however, I have adopted a plan which is nearly enough accurate for most practical purposes, and which possibly may be of interest to the readers of the "American Machinist." It is based upon the old practice of crushing disks of copper, of accurate size and supposedly known hardness, to a certain increased diameter, etc. The frequent use of copper in this form being somewhat expensive, a system was planned as a substitute, consisting of a similar use of bar-iron (usually ½ inch square), annealed by heating it red-hot and cooling upon dry ashes in a still atmosphere. Several bars of such iron, 4 inches long, were sent to a well-known testing laboratory and were crushed, when lying upon their sides, by being spread to an average of 9-16 inch wide and about 7-16 inch thick. Measuring the largest area of the same after crushing (in a plane normal to the line of pressure), it was found that the pressure required was approximately 72,000 pounds per square inch. Other experiments with ¼-inch square iron showed about the same results when crushed to 9-32 inch wide by 7-32 inch thick.

Based upon these figures, we find that each inch in length of the larger iron requires about 20 tons (of 2,000 pounds) while the smaller iron requires about 10 tons. No accurate experiments have yet been made as to how much less pressure is required for very short pieces, say ½ or 1 inch in length, when compared with the 4-inch lengths; but doubtless the pressure per square inch would be somewhat less, on account of the greater ease of the endwise flow of the metal when in short pieces.

For practical use, however, where no great accuracy of detail is required, but where large errors must be avoided, sufficiently good results have been obtained by using various short bars of 1, 2, 3, 4, 5 or 6 inches in length. These can be roughly cut off and annealed in the blacksmith shop at very slight expense, and can often be used several times over by reannealing them and using them turned up edgewise to be flattened in the other direction. For the more accurate final tests, however, it is better to use the new bars. When comparatively light pressures are to be measured it is better to use ¼-inch iron, because such little bars are not short enough in proportion to their width to produce large errors, by reason of the endwise flow above referred to.

Thus for testing the ram pressure, in any sort of a power, foot or screw press, under ordinary conditions of applying the power, all that is necessary is to insert a pair of dies, consisting of an upper and a lower hardened steel plate, ground flat upon their working surfaces. The ram of the press is of course adjusted until the little iron bars in question, which may be laid side by side between the plates, are crushed to the proper degree, reading the result in tons at the rate of 20 for each inch in aggregate length—that is for the ½-inch iron. The process for the ¼-inch bars is of course the same, using 10 tons as a unit.

In some cases it has been found practicable to test the pressure required for operating upon a given piece of work in a pair of dies. These dies are mounted in the press as usual, but with two flat steel plates beneath them, the little pieces of crushable iron being placed between these last-named plates. One interesting experiment recently made in this line was to ascertain the approximate pressure for drawing brass cannon-cartridge-cases at different stages of the descent of the punch, the stroke of the ram in this case being very long on account of the great depth of the work. Although a good deal of horse-power is required in a press of this kind, because the pressure is exerted through a long distance representing much of the ram stroke, the actual pressure at any one point is comparatively small. It was therefore necessary in the case, while operating upon a cartridge 3½ inches in diameter by 16 inches long, to use only a few of the small (¼ inch square) pieces of iron.

The above named system is adapted to be used in an ordinary shop by ordinary men, and the testing gets done—which it usually would not be if a more elaborate system was used. As a makeshift, moreover, it seems to answer pretty well. What is really desirable for such work is a device which I have for several years intended to build, but which has never yet been started. For want of a better name, it may be termed a "weighing bolster."

This should be in the nature of a spring balance or a hydraulic balance, or otherwise, which could be bolted upon the bed of any ordinary press, with a pair of dies placed on the top of it—the upper die being mounted in the ram as usual. In many cases it would be desirable that there should be a hole of several inches in diameter entirely through the bolster, that the work from the dies might drop freely.

On account of the limited room usually available between the bed and the ram of a press, this bolster should not be more than 3 or 4 inches thick, with a width from front to back of some 12 to 16 inches, and with a length from right to left of perhaps twice as much. It should be capable of weighing pressures from, say, 100 lbs. to 200,000 lbs. It should, preferably, be a recording instrument which would make a chart somewhat resembling a steam

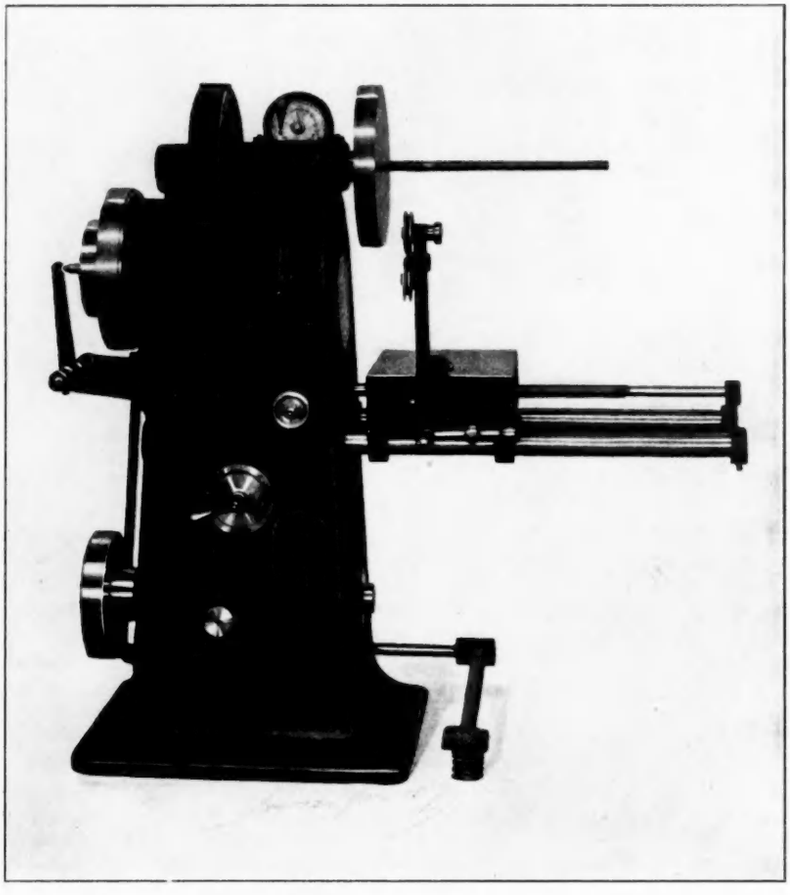


FIG. 1. MAGNET COIL WINDING MACHINE.

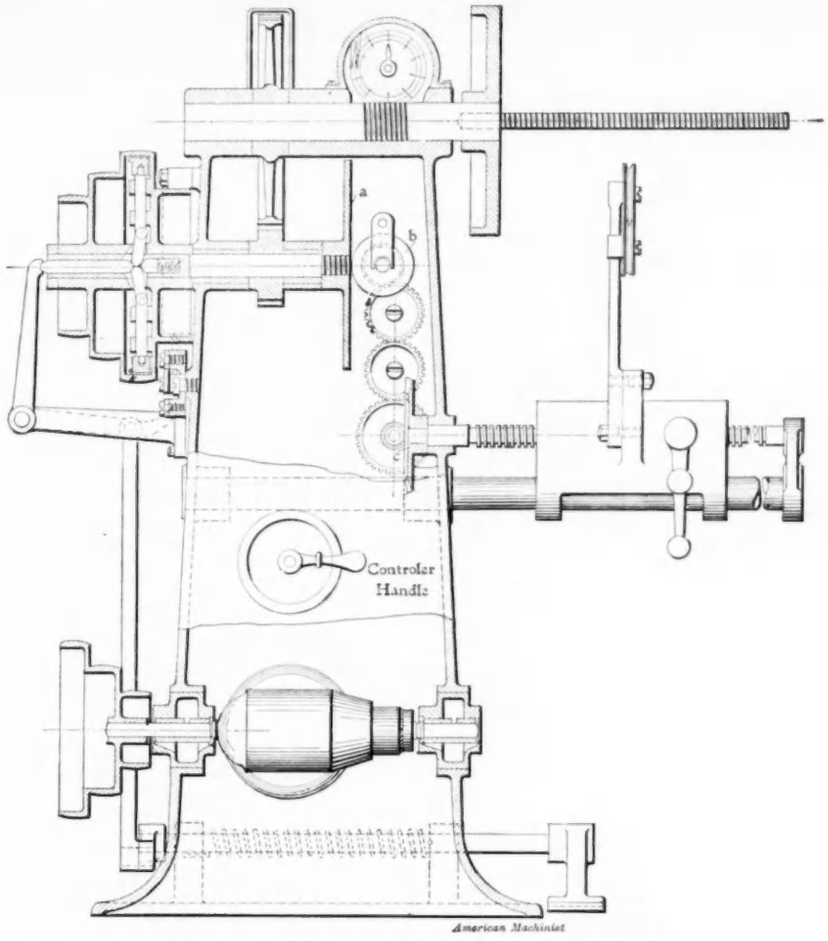


FIG. 2. SECTION OF MAGNET COIL WINDING MACHINE.

It consists of a housing completely enclosing the driving motor and containing seats for all the bearings. The winding spindle carries a face-plate with threaded rod in the center for clamping the various forms against the plate. A carriage, similar to that of a lathe, carries a guiding roller and means for keeping the wire tight. The carriage is provided with automatic feed in both directions, driven by friction disks *a b*, Fig. 2. The rate of feed is determined by the radial position of *b*, which may be adjusted to suit the size of wire being wound, by a small crank handle shown at the left of the face-plate in Fig. 1. The feed can be instantly reversed without stopping the machine, by pulling or pushing the polished knob in front of the machine, at the left of the carriage, Fig. 1, which engages one or the other of the bevel pinions with the gear *c*, Fig. 2, on the feed screw. Speed changes are made by using cone pulleys.

The movements of the spindle are controlled by the foot-lever, which operates a friction clutch and brake, shown in Fig. 2, the action being such as to give the operator perfect control of the work. The instant the clutch is disengaged the brake is applied and prevents the spindle from turning backward and loosening the wire. The spindle can be revolved continuously or inched, as desired.

The carriage is provided with hand feed for quick adjustments. The feed screw is connected to the carriage through a revolving nut, the hand feed handle being geared to this nut. This arrangement allows the operator to adjust the carriage forward or backward while the machine is in motion, to compensate for any inequalities in the wire.

It being necessary in this work to know the number of turns of wire on all coils, a revolution counter is provided, the construction of which is shown in Fig. 3. It consists of three disks *a*, *b*, *c*, all mounted upon the same stud. The first one *a* has 100 teeth, which engage with the worm cut on the winding spindle. The second

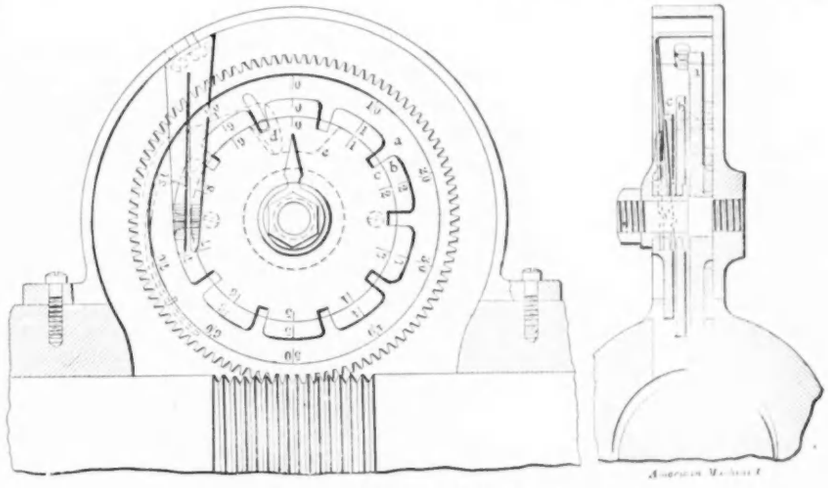


FIG. 3. DETAIL OF THE COUNTER.

cylinder diagram. The ordinates of the curve would perhaps represent the pressures (reading in pounds) at various points of the ram's motion, while the abscissæ would represent the total inches of ram descent, or *vice versa*. In the latter case the ram could carry a pencil, mounted upon a slide or lever which would be pulled sideways by the pressure-indicating finger.

A device of this kind has, I think, never been made, nor is it easy to make, as the vertical available space is very limited and the variations in pressure are exceedingly great. There would not seem to be sufficient demand for a tool of this kind to warrant anyone expending a great deal of money upon its development. It is, however, very desirable that something of the kind should be made available for testing the working of materials in dies, that this interesting art may become a more exact science than it is now, or ever has been.

In considering various methods of operation for such a device, it will be found that the spring-balance principle is not readily adaptable to the great range of pressures required, and that the use of hydraulic pressure would depend upon hydraulic measuring gages being more accurate than those usually made, which are not supposed to be extremely reliable. The use of a mercury column would be much more definite, but probably would prove impracticable, on account of the large range of pressures necessary.

Bridgeton, N. J.

Winding Machine for Magnet Coils

This machine, the general construction of which is shown in the accompanying illustrations, was designed for winding the various coils used in the construction of electric motors and generators.

disk *b* has ten notches, one of which is deeper than the others, and the third disk *c* has ten notches, all the same depth. The first disk carries a small lever *d*, one end of which is pivoted to the disk, the other end bearing on a cam disk *e*, fastened to the frame. This lever has a pin projecting through a slot in the large disk. The cam is so proportioned that the pin will drop into a notch of the second wheel once every revolution and move it one space. Every tenth revolution it will drop into the deep notch and move the third disk one space. Arranged as shown, it registers up to 10,000 turns.

The motor and its controller are built into the base of the machine, which is made by Jas. Clark, Jr., & Co., of Louisville, Ky., from designs by Chas. E. Willey.

The Principles of Cost Accounting.*

BY F. A. HALSEY.

The young engineer is apt to look upon bookkeeping as not only outside of his province, but as somewhat beneath his dignity. The day book and the ledger savor of the sordid and purely clerical side of business, with none of the glory or even personal pride and satisfaction that properly go with the materialization of one's brain work in steel and iron. Nevertheless, the building of machinery is primarily a matter of pure business, and nothing connected with its business side is beneath the notice of the engineer; and, in fact, the engineer who lacks appreciation of this fact, or who belittles it, is an engineer of inferior grade only. Every young engineer—and old one, too, for that matter—who is disposed to exalt the technical and belittle the business side of engineering should read the presidential address of Eckley B. Coxe, delivered before the American Society of Mechanical Engineers at the Montreal meeting of 1894.

Not only is it true that cost-accounting is not beneath an engineer's notice, but as a matter of fact it is especially and peculiarly within his province. More than this, he will find here problems worthy of his best mental efforts—problems which differ with every establishment to be considered—problems to which no rules apply except the highest rule of all—the rule of judgment. Cost-accounting is entirely without the range of bookkeeping as usually understood. Bookkeeping in the usual sense is, on its face—but on its face only—almost as exact a science as astronomy. Look at the annual balance sheet. Every item bears the stamp of exactitude, and the final balance is correct to the last penny. In point of fact, however, most of this appearance of exactness is fictitious, and, moreover, the items which are really exact are mostly on the wrong side. We can easily tell what our liabilities are—that is, how much we owe—to a penny, but most of the assets contain, as they must, a large element of guesswork. As a cultivator of a smug, complacent confidence in figures, I know of but one competitor to the annual balance sheet, and that is the parallelogram of forces. Both apply exact processes to inexact data.

Unlike the bookkeeper, the engineer almost never deals with exact figures, nor, having inexact figures, does he, if he is wise, draw exact deductions from them. He understands the meaning of a margin of error and attacks every problem with a margin of error in view; and it is the habit of mind consequent upon this habitual view of things, together with a knowledge of fundamental conditions, which makes cost-accounting an engineer's and not a bookkeeper's job. So true is this, and so well is it becoming recognized, that one engineer—Mr. J. N. Gunn—has for the past fifteen years made a specialty of the introduction into large works of cost-accounting and other office systems.

The cost of a machine to its producer is composed of three items—material, labor and burden. The term material explains itself, but labor is here used in a restricted sense, and means the wages of those operatives whose time is so spent that it can be accounted for and charged to the separate articles made. Such labor is properly defined as direct labor, though more commonly called productive labor. By burden is meant a factor which is added to the cost of material and direct labor to cover such items of the cost of production or of the conduct of the business as cannot be directly charged to the individual pieces produced. The burden is made up of many items, such as the cost of rent (if the business is conducted in rented quarters), of salaries, power, heat and light, insurance, taxes, and what is properly called indirect labor, though more commonly, but erroneously, called non-productive labor—by which is meant the labor of men who appear on the weekly pay rolls, but whose labor is of such a nature that it cannot be directly charged to any individual article produced for sale. Among such men are the foremen, the engineer or fireman, and many of the helpers or laborers about the shop, crane operators, etc.

The problem of cost-accounting resolves itself principally into burden-accounting; that is, into determining and apportioning the burden. The determination of the total burden may be made with comparative ease and with a satisfactory degree of accuracy, and, more than this, the total may easily be so divided among the different pieces of work that we may be sure it is all charged against something. To accomplish this much is to acccomplish a great deal. If this much is done, it follows that were an entire year's production present in the warehouse on inventory day the total inventory value of the year's production would equal the true total cost, and this in spite of the fact that some items might be over and some undervalued. While, however, it is not difficult to make sure that the work as a whole carries the whole burden, it is by no means easy to insure that each piece of work carries the portion of the burden that it should—in fact, real accuracy in this respect is impossible. Very few machine-building establishments make any attempt at it, though many think they do, nearly all being satisfied with a method which insures, as said above, that the whole burden shall be charged against something. Their methods are not to be condemned on that account, for, under some conditions, the results are fairly satisfactory—as satisfactory probably as the most elaborate methods are under the conditions that make them necessary. The chief disturbing factor which renders such methods unsatisfactory and makes more elaborate methods necessary to insure fairly satisfactory results, is the presence in the shop of large expensive machine tools.

I wish at the outset to avoid the formation of an impression that a discussion of the method of distributing the burden is in any sense a case of hair-splitting. On the contrary, in this burden we have to deal with large and important sums.

Mr. Gunn, who has already been referred to as an expert in these matters, and who probably has a larger knowledge of actual conditions in existing factories than any other living man, recently stated as the result of his observations that "it is the exception to find a machine-building plant in which the factory expenses [burden] are less than 100 per cent. of the direct labor." In this figure Mr. Gunn does not include office or selling expenses.*

It is obvious that if the gross sum constituting the burden is thus as large as the total direct wages paid out, the correct distribution of the burden among the different pieces of work done is just as important as the correct distribution of the direct wages. In point of fact, it is often more so, for there is often a much greater difference in the burden properly chargeable to individual tools than there is between the wages of the workmen who operate the tools. In other words, the calculation of costs by the use of a flat average rate of wages would, in many cases, lead to smaller errors than does the very usual method of a flat average charge for the burden. A moment's consideration will make this clear. Two of the items which go to make up the burden are interest and depreciation, a rate per annum for the sum of the two which is often used being 10 per cent. Assume a small centering machine costing, say, $100, and the charge for this item will be $10 per annum, or, assuming 300 working days per annum, the charge will be 3⅓ cents per day. Assume, on the contrary, a large boring mill or planer costing, say, $15,000,

*A lecture delivered before the mechanical engineering students of Cornell University.

*Mr. Gunn's words may be found in full in our issue No. 18 of last year, page 419.—Ed.

and the charge becomes $1,500 per annum, or $5 per day—a ratio for the two machines of about 150 to 1. The boy running the centering machine would probably receive 50 cents per day, while the man running the boring mill would receive about $3 per day—a ratio of 6 to 1.

If we average the wages and charge each machine with $1.75 per day, we will overcharge the centering machine by $1.25 and undercharge the boring mill by the same amount, whereas if we average the burden, as is often done, we will overcharge the centering machine and undercharge the boring mill with, approximately, $2.50 per day; the error due to averaging the wages being but one-half of that due to averaging the interest and depreciation, which are but two items of the burden. It will be seen that in the case of the centering machine, the burden due to interest and depreciation is insignificant, but in the case of the boring mill it is more important than the wages of the operator.

Some useful lessons may be drawn right here. One is an explanation of the customary saying that one must not go to a large shop to have small work done. It is a fact that competitive bids from large shops usually show higher figures for small work than those from small shops—other conditions being of course substantially the same. The explanation often is, no doubt, that the large shop uses some flat rate or average method of distributing its burden, and in so doing charges against the small tools much of the burden that belongs on the large ones. The small shop has no large tools, and is thus prevented from making such an error. Inasmuch as small work is done on small tools, it follows at once that the small shop bids the lowest on such work.

Another lesson is the serious nature of an investment in large tools. Such tools are great burdens and should be installed only when absolutely necessary. It is far better to depend on neighbors for occasional large pieces of work or to do them by primitive and makeshift methods, even though those methods apparently consume an extravagant amount of money in wages, than to be burdened with expensive machines which cannot be actively employed. In other words, as regards heavy tools, the under-equipped shop is better off than the over-equipped one—which is but a single illustration of an almost universal truth, that in any branch of machine-shop equipment or management under-doing is better than over-doing.

When we come to consider the burden in detail, a problem arises at the very start—namely, what shall be included in it? It is a very common method to include all expenses other than the cost of material and direct labor, including expenses of administration, salaries and traveling expenses of salesmen, and in fact all items of expense up to the delivery of the goods to the purchaser. This is looked upon as the conservative course, and even as necessary for self-protection and safety; it being considered that one should not deceive himself by making his costs appear lower than they really are. This is a fundamental error, and in some circumstances it may even be a dangerous one. The error arises from a lack of appreciation of the fact that there are really two costs to be considered—the cost delivered into the maker's warehouse and the cost delivered to the consumer. The latter cost is the one to be considered in making prices, and it should certainly include all these items; but in estimating the value of a business the warehouse cost is the one to be considered, and it is the very opposite of conservative to make this appear high. The practice of which I speak is due to a confusion of these two costs, or rather to the ignoring altogether of the cost delivered into the warehouse.

The difference between these two costs is due to the expense of making sales and deliveries, in case delivery is included in the price. Such expenses are properly items of the cost of selling and not of manufacturing, and, while they are a necessary expense to the business, they form no part of the cost of making the goods—they represent the cost of getting them from the warehouse to the purchaser. It may appear at first sight that the distinction is unprofitable and unimportant, but while always wrong in principle, it may in fact be unimportant or it may be very important, according to the nature of the business done. In this respect, as in many others, the methods of cost-accounting are largely matters of adjustment to circumstances.

To explain why the distinction is sometimes important and sometimes the reverse, assume first a business in which all work is done on special contract, the work being begun after the sale is made, and, when completed, going directly from maker to purchaser. In such a case the warehouse cost is of no importance, except as it affects the work actually in progress, or completed but not shipped, when inventory day comes around.

On the other hand, assume a manufacturing business in which the efforts of the shop are directed toward keeping the warehouse stocked with goods and in which the efforts of the salesman are directed toward the selling of those goods. If the business is of such a nature that its trade is widely extended in point of territory, calling for stocks of goods to be carried in numerous places, and if the item of repairs is a large one and calls for large stocks of parts as well as of complete machines, the case is still stronger. In such a case the value of the manufactured goods on hand forms a large item in the assets of the business.

In a business of the class first described, the chief object of cost-accounting is to determine what price shall be charged for the goods made, and since this price must include the selling expense, no error of moment, except one of principle, is involved if the selling expense is included in the cost.

In the case of a manufacturing business, cost-accounting has a second object quite distinct from, though no less important than the first—namely, the determination of the value of the goods which are not yet sold, but which remain in the warehouse and are thus an asset of the business and must appear as such on the annual balance sheet. In a business of this kind cost-accounting is, in fact, rather remotely connected with prices.

The fact that costs are high in any given shop does not enable that shop to get higher prices than its competitors, and, conversely, the fact that costs are low does not involve lower prices than are obtained by others. The prices obtained are determined by the state of the market, and not at all by the costs in any individual shop. If the costs are too high, the shop loses money, and, on the other hand, the lower they are the more money it makes.

The surplus of a business at any moment is the excess of the assets over the liabilities at that moment. When the annual balance sheet is struck, the assets are determined from the main books and the inventory. To every item which appears in the inventory, a value must be given, and errors in these values vitiate the results shown by the balance sheet to the extent of the errors.

It is clear, moreover, that the error is not a percentage error—that is, a 10 per cent. error in the value of the assets does not give a 10 per cent. error in the surplus. The surplus being the difference between the gross assets and liabilities, an error in the former reappears in the latter and if the assets are large and the surplus small, an error which would be a small percentage of the former might be a large percentage of the latter.

I think it is apparent by this time that in a business of this kind our entire knowledge of the condition of the business, of the amount of the surplus and, in short, of how much the business is worth, is wrapped up in the system of cost-accounts.

Nothing is so easy in business as to inflate one's assets, and there is nothing which the prudent man exerts more effort to avoid. Such inflation is dangerous to the last degree. It leads to a false sense of security and to the payment of larger dividends than are justified. It may even, for a time, convert real losses into apparent gains and lead to the payment of dividends when assessments would be more in order.

It should be noted right here that there is no compensating error possible in respect to the liabilities. The liabilities, except as regards matters in litigation or dispute, can be determined to a penny. We can always determine just what we owe and must pay, but of our assets there is

scarcely an item, except cash on hand or in the bank, which can be determined with positive accuracy. Even the accounts receivable are subject to a discount for bad debts which cannot be collected.

It will be seen at once that to include office and sales expenses in the burden would at once, and largely, increase the apparent value of all manufactured goods on hand, and by so much increase the apparent surplus, and that the direct effect of such a course is to inflate the business and give it an apparent value, which in fact does not exist—in other words, the inclusion of these expenses as an item of cost, instead of being, as is often assumed, a conservative course, is in reality the direct reverse.

Moreover, it is easy to show that the course is not only dangerous in practice, but that it is wrong in principle. These office and sales expenses form no part of the expense of manufacturing. The goods could be made just as well if the office were closed and every man in it discharged. They could not, however, be sold, and the office organization is for the purpose of selling them.

The effect of including such expense items in the burden is to increase the valuation of every article in the warehouse by an amount drawn from them. In other words, and this is the crux of the whole matter, the effect of this plan is to write the *expenses* down in the inventory and to *transfer them thence to the balance sheet as an asset.*

The expense of the office, then, is chargeable to sales and not to production and we arrive at the basic principle that the burden should include such expenses as are necessary to the operation of the factory, and nothing else. That is, it should include such items as rent—if the building is rented—salaries of superintendent, foremen and time and cost clerk, power, heat, light, insurance, repairs, supplies and such labor as the engine-room force, helpers, laborers, etc.

(Concluded next week.)

Molding a Crosshead Guide With a Pattern Which Makes its own Core.

BY R. H. PALMER.

The pattern is shown in Fig. 1. It is so made that the core forming the inside of the casting is built in the pattern as the molding proceeds. The pattern is split lengthways and both ends are left open.

The pit having been dug, and binders *A*, Fig. 2, placed, and eyebolts, shown in dotted lines at *A*, Fig. 4, placed in slots in the ends of binders, sand is rammed around them and struck off level. Planks *B*, Fig. 2, are placed on binders and uprights *B*, Fig. 4, on the planks. Sand is rammed around the uprights and on the planks to a depth of about 9 inches. Pockets of cinders are formed, *C*, Fig. 2, and pieces of gas pipe are run from them to above the floor. A little straw or hay is next covered over the cinders, and, if this is not at hand, old newspapers are used, which will keep the sand from finding its way among the cinders, thereby helping to close up the pockets or spaces between the pieces of coke or cinders. More sand is now rammed on, and at the same time it is made to conform somewhat to the shape of the lower half of pattern. The ends of this bed are well vented down to the cinder or coke pockets, taking care that the vent wire goes through the paper, if paper is used.

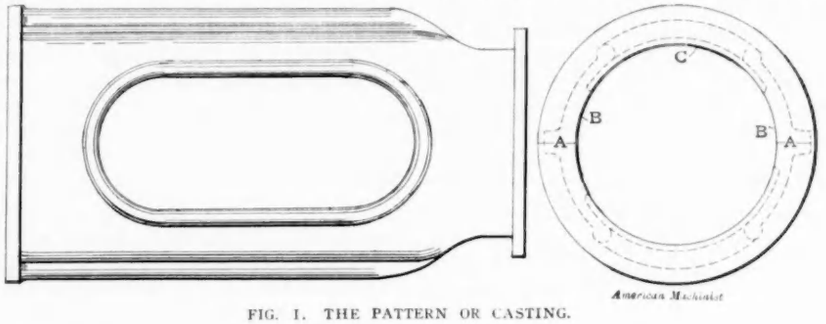


FIG. 1. THE PATTERN OR CASTING.

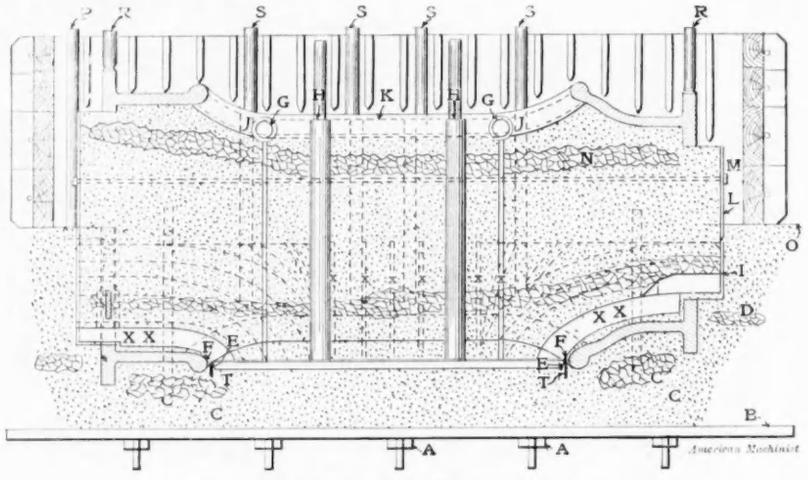


FIG. 2. VERTICAL SECTION OF MOLD IN PROGRESS.

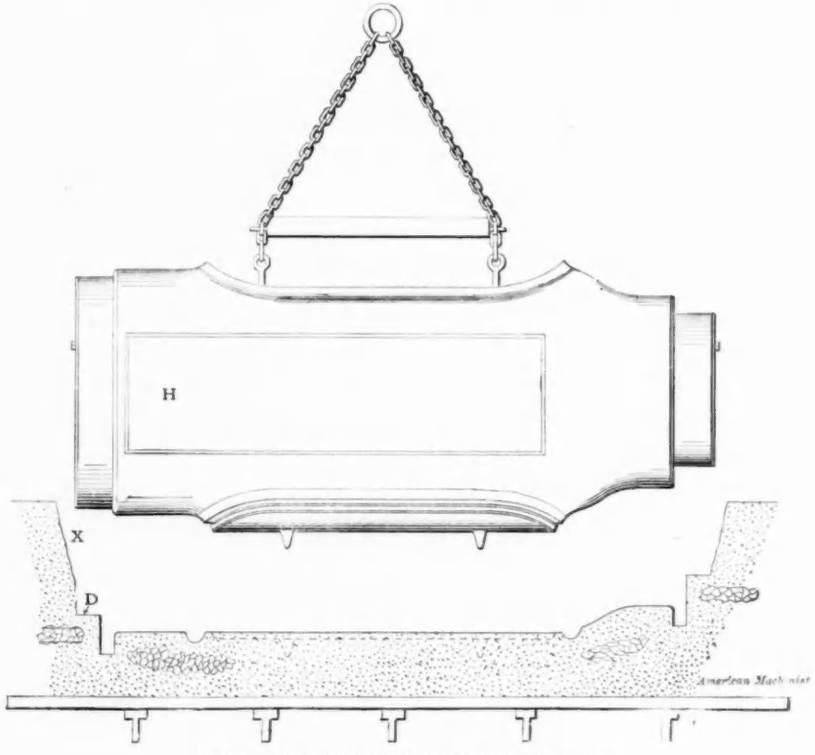


FIG. 3. LOWERING THE CORE INTO POSITION.

The lower half of the pattern is now placed in position and wedged up where necessary, leaving room to ram the sand and to tuck facing sand next to the pattern. As the work advances, iron rods are laid in a course around on the sides, to help support the sides of the mold. The gate cores and uprights *C*, Fig. 4, through which the mold is to be filled, also are placed.

The sides of the pattern are braced apart while this is being done, as the pounding and the pressure of the sand on the outside would have a tendency to force the sides of the pattern in. It is also weighted with pig iron on the inside, to keep it from being lifted as the sand is rammed under it. About halfway up to the joint a pocket of cinders may be placed on each side, first giving the sides a good venting and then placing the cinders over the vents.

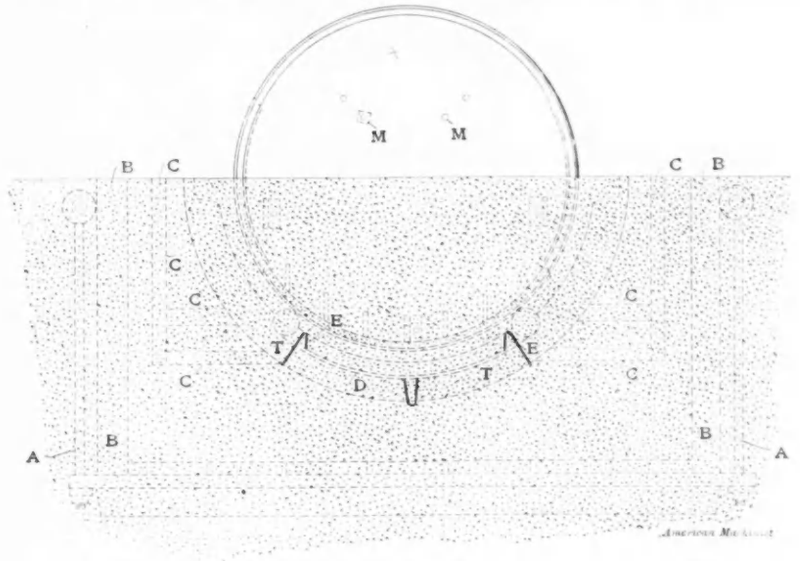


FIG. 4. CROSS-SECTION OF LOWER PART OF MOLD—CORE IN PLACE.

The print for the core is now formed at each end of the pattern by striking off the sand on the line *D*, Figs. 2 and 3, following the circle *C*, Fig. 1, in the lower half, but at each end, making the print actually longer than the pattern.

The sand is next swept curving in the center to line *D*, Fig. 4, and the grid, carcass, or whatever may be the local name for it, is then tried in and rapped down to a bearing. In forming this bed, it must be made firm, as there is a great deal of weight coming on it. As the casting's edge is rounded, and has a bead on it, the parting must come part way up in the opening; so, to avoid danger of crushing the edge when closing, and to guide it to a bearing, the edge of the plate is beveled at *E*, Figs. 3 and 5. A parting is made on a line with the plate at *F*, Fig. 2, thus leaving an amount of sand sticking up between the plate and the casting. This carcass is of open-work construction, and consists of bars *x x*, Fig. 3, cast on at the ends and sides to the plate forming the bottom, but the round plates on the ends are bolted to the bars, and also have two bolts extending the whole length of core, as *M*, Figs. 2 and 4. When the casting is cleaned they are unbolted and removed, and the carcass is taken out of the opening in the large end. This carcass is not a close fit and is gaggered as any cope may be.

For lifting out this core eyebolts *G*, Fig. 2, are screwed into the plate and pieces of wood *H H* are stood on the plate, extending up to the joint. The core is now rammed up to line *I*, Fig. 2, given a good venting and the vent covered with a layer of cinders and then with paper. Gatesticks *I*, Fig. 2, are set extending to joint *K*.

The facing and ramming in of sand is continued, with some rodding, to the joint line; the edge of the pattern is cleaned off, the top half is placed, and the building up continues. When a point is reached a few inches above the joint the core is rodded crossways, in order to tie it together. In building cores of this kind the heavy core must be built to withstand strains in lifting and handling as well as the strain of pouring. In making a core that is to be dried in the oven it is acknowledged that a core must be rodded to a certain extent to give it strength, even when baked. A mass of sand like this, weighing with the carcass some three tons, must be all the more well secured when it is remembered that it is nothing but green sand, or molding sand, and again, when the cope comes to bear on it, were it not rodded together, a little too much pressure might crack it.

At *N*, Fig. 2, the mold—or core, rather—is again vented and cinders are placed. The core being rammed up to joint *K*, Fig. 2, and that joint made, the joint *O* at the parting of the mold is made.

The cope is now lowered, resting on the uprights *B*, Fig. 4, and after being placed in position is staked, hoisted off, claywashed and replaced. Gatestick *P*, Fig. 2, is placed for pouring, the cope is rammed to the right hight for setting gatesticks *S*, Fig. 2, which are to be connected with gates *J*, which are to bring the vent from the pockets of cinders inside the core. Also spuds *H*, Fig. 2, which are to hold down the upright pieces of timber which rest on the plate of the carcass and at the proper time gatesticks *R* for risers. In venting the cope it is simply done from the top by a long vent wire.

A few raps are given on gatesticks *R*, Fig. 2, which serve to loosen the pattern from the cope, and the cope is hoisted off, rolled over and finished. The cope half of the pattern is now removed and a vent wire is used, and the core is vented on top down to the cinder pocket *N*, Fig. 2, and any other places where there is a question of the vent coming off properly, and the vent holes are covered in.

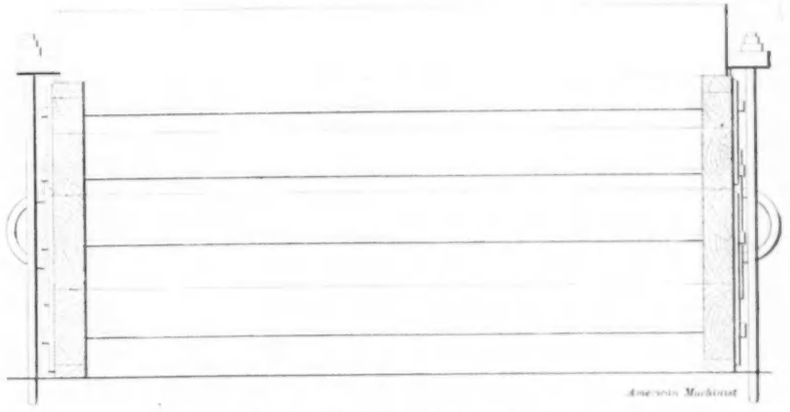


FIG. 5. END OF COPE—MOLD FINISHED.

The crane is now used and chains are hooked on to the eyebolts, and the core is lifted out of the lower half of the pattern and finished. The lower half of the pattern has a channelway cut around it and a large vent wire is run down from the channelway to the pockets of cinders along the sides and under the ends, thus bringing to the point where provision is made to carry it up through the cope.

The gatesticks for pouring are loosened

and a row of nails, as *I*, Fig. 4, are forced into the sand standing between where the plate of carcass is to rest and the pattern, to strengthen the sand. The pattern is then removed and the mold finished.

The mold being ready for closing, it will be seen that the sand has been dug away at each end of the core *x*, Fig. 3. It should have been said that this was done before the core was lifted out, which does away with the sand being crushed down into the print when closing. When the core is being lowered into the mold, Fig. 3, taken as a whole, will give a general view as it would appear, and Fig. 4 as it would appear with the core in place, and Fig. 5 is the mold closed with end view of cope with runner built.

The panel seen at *H*, Fig. 3, or guides inside the casting, may be loose from the pattern and held in position by wire pins which are withdrawn as the sand is rammed up to them. Where it is shallow it can be made a part of the pattern and the draft on it arranged accordingly.

The above casting weighs some 4,500 pounds. When hoisted from the pit the plates at the ends are removed and the core is easily dug out and the carcass removed.

The National Cash Register Company's Experiment.

BY F. A. HALSEY.

It is always easy to be wise after the event, and perhaps what follows will be dismissed by many with that remark. Undoubtedly it cannot have the force that it would have had if written before the strike at the Dayton works, but, notwithstanding that fact, it is nevertheless true that I have not, and never have had any faith whatever in many of the efforts made by the National Cash Register Company in the line of what has come to be called "social betterment."

It is impossible for anyone to doubt the high aims of the president of the company, Mr. Patterson, in doing as he has done, and all can, in a measure, realize the disappointment that must attend the outcome of so much well-meant effort. In view of it all we can understand that at the present moment "the heavens are brass" to him, and he certainly has my profound sympathy, not only for the business complications growing out of the strike, but still more for the disappointment that must attend the failure of plans into which he has thrown his whole heart and soul—a disappointment that must be all the more keen by reason of the apparent success of those plans, until recently, and the prominence which has been given to them because of this apparent success.

Belief in Mr. Patterson's entire sincerity and sympathy for him in his disappointment do not, however, change my belief that, as a means of improving the relations with his employees, a great part of his work is, and was bound to be, null, void and of no effect.

This belief is not based on the common and flippant remark that workmen "do not appreciate what is done for them," but on the fact that no one with a well developed sense of self-respect, whether workman or other employee, wants anything "done for him" by an employer beyond just treatment, the provision of a comfortable place wherein to work and payment for services rendered.

To avoid misunderstanding, it is advisable to say that I believe in clean, spacious, well-heated, well-lighted and otherwise well-ordered shops, with every reasonable appliance for the convenience and comfort of the workmen. I believe in the suggestion box and the complaint box and in payment for suggestions and ideas.*

I believe in provision for eating the noonday luncheon in comfort and am willing to admit the shop dining room with hot lunches supplied at cost, but not with hot lunches given away. I believe in these things because they are done primarily for the good of the business and not as a good will offering to the workmen. They conduce directly to good and economical work and they tend directly to assist in getting and keeping good men without any feature of patronage or paternalism. What I do not believe in is the flower gardens, the kindergarten, the library, the lecture course, the cooking school, the "rest room," etc.

In principle at least there is a sharp line of demarcation between these two lines of action by the management. One tends directly to more efficient production while the other is simply a good-will offering. A hot luncheon is a better foundation for an afternoon's work than a cold piece of pie. The kitchen and lunch room are thus justifiable, and similar justification exists for well-warmed and well-lighted shops, and for the other things approved above. A distinction may be drawn regarding the library. So far as it relates to the work in hand, it supplies information which tends to increase the efficiency of the workmen and its cost may thus be many times returned. To that extent it is justifiable, but in so far as it supplies mere "reading matter" it can produce no tangible return and is not justifiable.

The National Cash Register Company's business is generally understood to be highly profitable. This is as it should be. The company has done a public service in supplying these machines and it is entitled to its profits thereon. We all know, however, that workmen are not experienced in these matters. They know but little, because they have but little opportunity for learning, of the magnitude of manufacturing and selling expenses, and they uniformly overestimate the extent of the profits made. In my opinion these outside enterprises of Mr. Patterson's have simply confirmed these exaggerated impressions. His workmen have seen him spend large sums in directions that produced no tangible returns, and such expenditures have strengthened their feeling that the company is "rich" and they have asked: "If it has money to spend in such ways, why is it not able to raise wages or shorten hours of labor?" In other words, these very expenditures, instead of leading to a spirit of content, have led to discontent.

This brings us to the crux of the whole question. In this world men work for pay. The Saturday-night pay envelope contains the tangible results of a week's toil. The natural desire of every man is first to increase the contents of that envelope and second to shorten his hours of work. What to him is the cooking school, etc., compared with an increase in the contents of his envelope? Moreover, *his pay he earns, but the cooking school is a gift.* At the same time he feels that the gift would not have been made had it not been deserved, and if deserved he would infinitely prefer to spend the money himself than have others spend it for him, even though he gets less for it. In other words, I believe that the sums which these things have cost would have done far more toward cultivating the desired spirit of cooperation if given in the form of increased wages than if spent as they have been. If it be shown, as it doubtless can be, that these sums would have made but a trifling increase in wages the situation is not changed. *The men believe otherwise.* They have seen large sums spent, how much per man per day they do not know nor much care, but they believe the amount to be larger than it is. Regardless of the amount the principle is the same. Money which might have been paid in wages, where they want it, has been diverted to other purposes for which many or most of them care nothing.

To sum it all up, in this world men want pay, not gifts. Raise an employee's wages and you add to his self-respect; systematically make presents to him and you cultivate the spirit of a waiter dependent on his tips, and if he has the self-respect to resent this, as he should, the gifts lead not to friendship but to enmity.

Men value their positions for many reasons, but first of all in accordance with the incomes which they provide, and this brings me to my hobby—the premium plan. I know perfectly well that there have been strikes against that plan, but never yet under circumstances comparable with those at Dayton. The strike at Dayton occurred after Mr. Patterson's plans had been in progress for several years and were well understood. The strikes against the premium plan have been against its introduction, before it was understood and before it had had a chance to show its practical workings. Repeated experience has shown that while cheapen-

* I do not, however, believe in giving a few prizes for the best suggestions, and taking the others without payment. All ideas used should be paid for in accordance with their worth, the relation of the parties being simply that of buyer and seller. The very term "prize," carries with it the idea of that most hateful word, gratuity.

ing production it does raise wages, and by a greater percentage, I believe, than has ever been demanded in any strike. It is no gift enterprise and deals in no gratuities. The present machinists' strike prevails alike in shops that have it and in those that do not have it. In other words, it has not sufficed to introduce breaks in a wide-spread strike movement like the present one. That its tendency is right is, however, beyond question, and, once well introduced, with its workings made plain by experience, it will, I believe, go further toward insuring against industrial discord than all the altruistic tails which can be attached to the workshop kite.

Table for the Strength of Gear Teeth by Diametral Pitch.

We publish herewith a table for the working strength of gear teeth, which has been furnished us by the New Britain Machine Company. It is based on the Lewis formula, and, unlike other tables, gives the strength of the teeth when their size is indicated by diametral pitch. But one width of face is given for each pitch, this face being, as near as may be, that used by the makers of standard gears for the market.

The figures in the body of the table give the working load in pounds for a speed of 100 feet per minute for cast-iron gears of the pitch and face found at the top of the corresponding column and of the number of teeth given at the left of the corresponding line. The left-hand figure at the top of each column gives the diametral

This table is based on the Lewis formula, $W = s\ p\ f\ y$, in which W=Load transmitted by the teeth in pounds; s=the safe working stress of the material; p=circular pitch; f=the face of gear in inches; y=the tooth factor for 15 degree involute or cycloid

SPEED OF TEETH IN FT. PER MIN.	100 OR LESS	200	300	600	900	1200	1800	2400
CAST IRON	8000	6000	4800	4000	3000	2400	2000	1700
STEEL	20000	15000	12000	10000	7500	6000	5000	4300

s, FOR DIFFERENT SPEEDS

NO. OF TEETH	Y	DIAMETRAL PITCH AND FACE OF STANDARD GEARS												
		4 x 2	5 x 1¼	6 x 1½	7 x 1⅝	8 x 1¼	9 x 1⅛	10 x 1	11 x ⅞	12 x ¾	14 x ⅝	16 x ½	20 x ⅜	24 x ¼
12	.067	842	589	421	331	263	210	168	134	105	75	53	31	17
13	.070	880	616	440	346	275	220	176	140	110	78	55	33	18
14	.072	904	633	452	356	282	226	181	144	113	81	56	34	19
15	.075	942	660	472	370	294	235	188	150	118	84	59	35	20
16	.077	967	677	483	380	302	242	193	154	121	86	60	36	20
17	.080	1005	704	503	395	314	251	201	160	125	89	63	38	21
18	.083	1043	730	522	410	326	261	208	166	130	93	65	39	22
19	.087	1093	765	548	430	342	273	218	174	136	97	68	41	23
20	.090	1130	791	566	445	353	283	226	180	141	101	70	42	24
21	.092	1157	809	578	454	361	289	231	184	144	103	72	43	24
23	.094	1180	827	592	464	369	295	236	188	148	105	74	44	25
25	.097	1218	853	610	479	381	305	244	194	152	108	76	46	25
27	.100	1257	880	628	494	393	314	251	200	157	112	78	47	26
30	.102	1280	897	642	504	400	320	256	204	160	114	80	48	27
34	.104	1310	915	654	514	408	327	261	208	163	116	82	49	27
38	.107	1344	942	673	528	420	336	269	214	168	120	84	50	28
43	.110	1382	967	692	543	432	346	276	220	173	123	86	52	29
50	.112	1410	985	705	553	440	352	281	224	176	125	88	53	29
60	.114	1433	1003	717	563	447	358	286	228	179	127	89	54	30
75	.116	1458	1021	730	573	455	365	291	232	182	130	91	55	30
100	.118	1483	1038	743	583	463	371	296	236	185	132	93	56	31
150	.120	1508	1055	755	592	472	377	302	240	188	134	94	56	31
300	.122	1532	1073	767	602	479	383	307	244	192	137	96	57	32
RACK.	.124	1560	1092	780	612	487	389	312	248	195	139	97	58	32

American Machinist

TABLE GIVING SAFE WORKING LOADS ON THE TEETH OF STANDARD CUT GEARS OF CAST IRON RUNNING AT A SPEED OF 100 FEET PER MINUTE.

pitch and the right-hand figure the face in inches.

For higher speeds the loads are to be reduced in proportion to the figures given in the supplementary table at the top, and for steel gears the loads may be increased in proportion to the figures given in the same table for that material.

Fitting Up a Brass Foundry.

Several years ago it fell to me to plan for a new brass foundry in connection with a plant making brass fittings for steam and gas. The foundry was not a large one, employing six molders and the necessary core makers and laborers. The plan, Fig. 1, shows how the foundry was laid out and needs no explanation, except to say that it was about 45 feet wide and 60 feet long. The core makers had a

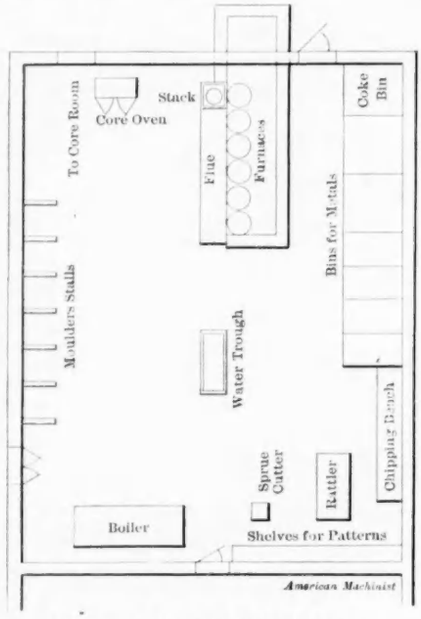


FIG. 1. PLAN OF BRASS FOUNDRY.

room attached to the main building, and as there was considerable yard room for the storage of coke only enough was brought in for each day and put in the coke bin, convenient to the furnace tender.

Over the furnaces was trolley and chain hoist to lift the crucibles and carry them to the clear space on the floor at the end of the furnaces, allowing ample space for the skimming and making ready to carry to the molds to pour off. The floor was paved, so that it could be swept each day and what brass was spilled in pouring could be saved. The paving was of good hard brick, but I think that vitrified brick would have been the cheapest in the end, as it is much harder and will stand harder usage.

Someone may wonder what a water trough is doing in such a prominent place. In a brass foundry a large trough of running water is a very necessary adjunct. In the first place, to get a nice color, such as is seen on valves and steam cocks, they must be dipped very quickly at a certain temperature determined by experience, and this cooling sets the color; although some use a cheaper metal and get the color by acid dips. The water also in the dipping cause the cores to blow out, leaving the insides of the casting clean, thus saving considerable expense.

The furnaces and their settings are shown in Fig. 2. The body of each furnace was made of two pulley rims *a* about 34 inches inside diameter, 13 inches face and 1 inch thick. The top and the two bottom plates *b* are made of cast iron, all from the same pattern. The two bottom plates are separated by two bars *c* 1½ inches thick, placed one on each side. The space thus made is for the grate bars *d*, which are of cast iron about 1 inch square by 40 inches long. The extra length protruding beyond the furnaces allows them to be caught hold of to be shaken, or to pull them out to dump the fire when the day's work is done. This is

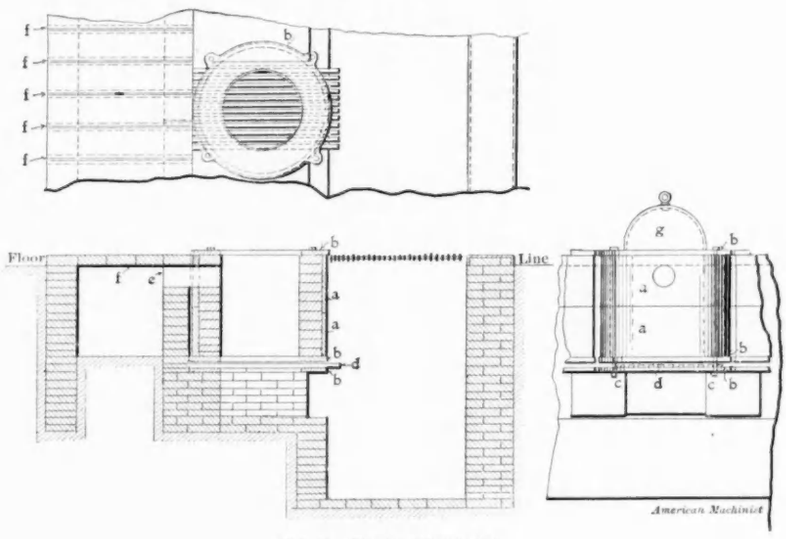


FIG. 2. BRASS FURNACES.

usually done by a pair of long tongs being worked through the grating.

The furnaces were lined with regular rectangular fire-brick (as they were easier to get in the open market and cheaper than the segmental shapes), taking care to well fill all the crevices with fire clay, and the space between the brick and the casing with pieces of old fire-brick and clay. The small connecting flue *e* between the large flue and the furnace was made of pieces of 6-inch wrought-iron pipe. A damper may be put in this pipe if so desired, but we did not find it necessary. The large flue was built of common brick and at the end of three years it was still in good condition. This flue was put up with the idea in view of having six more furnaces on the opposite side, when business demanded it. The brick top was held in place by cast-iron tee rails. This flue led to a stack 20 inches diameter by 40 feet high, which had an excellent draft.

The furnaces were set upon brick piers as shown, and the pit was made deep enough for a man to walk in front of the furnaces to shovel the ashes out. The pit, as shown in the plan, went outside of the building; this was so that the grating would not have to be taken up and also to keep the dirt made by handling the ashes out of the foundry. If there is room the part outside should slope up into the yard so that a wheelbarrow can be used in the pit. The ashes should be gone over very carefully to save any brass lost when filling the crucibles.

There should be a sewer connection in the pit, and the bottom should slope toward it, as water will sometimes get in, and should a crucible break while in the furnace and the hot metal strike the water there will be trouble. I remember such an accident several years ago the result of which was that the furnace tender took an enforced vacation of about 30 days for repairs to himself. The space in front of the furnaces over the pit is covered with an iron grating, and the wall around the pit should be protected with a coping of stone or iron. The cover *g* on the furnace is what is used by many, but something more flat would be better, as then the crucible of hot metal would not have to be hoisted so high to pass over the other covers on its way to the pouring floor.

In the old foundry the molders worked over a trough, Fig. 3, which held the sand and the flasks while the molds were being made, and such an arrangement, so far as I have ever seen, is common in brass foundries. The troughs were about 8 feet long and they were arranged around the sides of the shop next to the walls, taking up considerable space; in fact, so much that only a few men had the benefit of the windows, and then the troughs held only about enough sand for one heat, and as each man put up three heats per day, his sand was quite warm after the first heat, and hot sand is not the best thing for good castings. In the summer a foundry is not, at its best, a very cool place, and to have

to stand over hot sand and work was rather trying, to say the least, on the men.

It was decided to give the stall system, such as is used in snap flask foundries, a trial. One stall was put in, like Fig. 4, and given a fair trial, with the result that the molders found it easier to do their work, as the sand was in a more convenient position, and they also escaped that peculiar side movement they had to make in shoveling from the trough. They also had the benefit of plenty of sand always handy and in two piles, so as to use them for alternate heats, and thus escape the hot sand trouble. Each molder had a window, so as to get plenty of air and light. The bracket fastened to the wall held the flask while the mold was being put up, and was of a convenient hight for the molder and was made of 2x4-inch hemlock. The sides

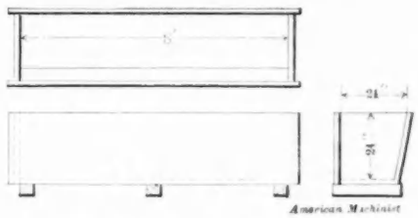


FIG. 3. MOLDING TROUGH.

forming the stall were of 1-inch hemlock plank.

The ledge to the left provided a place for the molder to lay the gate of patterns, matches, etc., when taken from the mold. His tools, parting sand, facings, etc., were on a shelf in front of him, and his riddle was hung on a peg within easy reach.

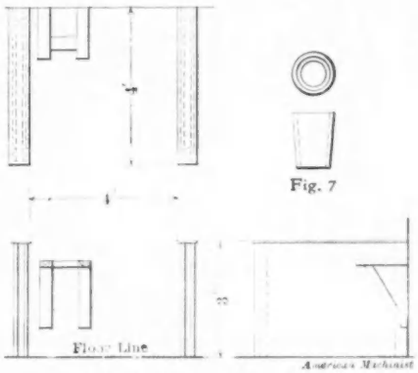


FIG. 4. A MOLDING STALL.

The sand he was using was in a pile at his right, at the upper end of the stall, and another pile to be used for the next heat was at the right-hand side of the entrance to the stall. While the heat was being poured one of the laborers shoveled this pile to the back end where the former sand had been. The flasks and follow-boards for each molder were placed on a line with the left-hand partition, so that no two molders came in contact with each other.

The core oven was a very simple yet very effective one, as can be seen by Fig. 5, and it can be built at very little cost. It will bake the cores very rapidly, as the heat is direct. The walls were of common brick and the top also, only the top bricks were held in position by cast-iron tee bars, as shown. The firebox needs no description, unless it is to say that the grate bars were of cast iron taken off the same pattern as the furnace bars were. The shelves to hold the cores may be made of 3-16 or ¼-inch boiler plate, punched full of ¾-inch holes to let the heat pass through the lots of cores on the different shelves. Cast-iron shelves might be better, as they would not warp; but I do not think the difference in results would pay for the pattern, as we found after several years' trial that the plate shelves had not warped enough to cause any annoyance, and for fuel we

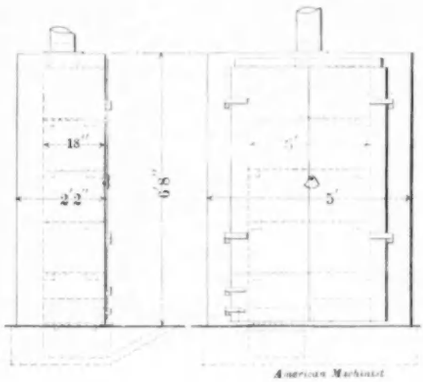


FIG. 5. CORE OVEN.

used gas-house coke, which makes a very hot fire.

The flue from the core oven was made of 7-inch stovepipe, such as one gets from the stove stores, and was run over to the stack leading from the furnaces. The doors were of sheet iron, with two of them on the fire side, so as to be able to get at the fire without opening the whole oven.

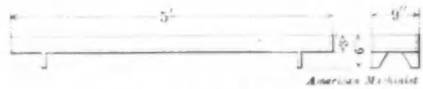


FIG. 6. POURING TROUGH.

Fig. 6 shows a cast-iron trough for catching the drippings of brass, when the molds are poured on the end, as in this position more or less runs off; and Fig. 7, although a very simple looking affair, was the cause of much happiness for the furnace tender, and sorrow for the watchman—in fact, it might be called in this case the "watchman's eye opener"—although it was merely an iron crucible without a bottom. In brass foundries there is much copper wire and clippings of sheet copper used, and this iron crucible was for forming these into convenient shapes for handling. The wire or clippings were pounded into it by using an iron ball about 4 inches diameter cast on the end of a rod, and, when no more could be pounded in, the pot was turned over and the mass was knocked out.

The dimensions given in this article are only general and can be changed to suit some other fellow's ideas, or surrounding conditions. I trust that this may be a help to someone who is groping for light on the subject as I had to do a few years ago. J. G. C. S.

Letters from Practical Men

The Education of Another Mechanic.

Editor American Machinist:

I attended public school among the mountains of West Virginia. On one occasion I heard a local politician arguing strongly against an increase of the school term from four months per year to six, on the ground that it would increase the tax rate too much. That same politician had six school children in his family, and he was assessed 10 cents per year school tax. As a result of such public sentiment, we had only a four months' school term in that district.

The hight of a pupil's ambition was to master "partial payments" and "cube root," and to be able to spell every word in the spelling book. He would then stop going to school, supposing he knew about as much as the teacher. I reached this goal before I was sixteen, and as my paternal ancestors for three generations or more had been disciples of Tubal Cain, I naturally chose to learn a trade.

I began a machinist's apprenticeship in a large railroad shop in Baltimore, at 7 cents per hour for the first year and an increase of an additional cent per hour for each of the three succeeding years. During the first year I attended a night school and studied writing and arithmetic. The following three years I attended a night school of mechanical drawing, and graduated with prize honors just about the time I completed my apprenticeship.

I worked a few months as a journeyman, during which time I saw several of my shop associates promoted, as I thought, simply because they had the "pull." I had no political friends of influence and no relatives in the employ of the company, and I concluded that my only hope of advancement was through a better education.

With $110 which I had saved during my apprentice-hip, I started to college and entered the preparatory department. By close application to study that year, and with the help of a tutor, the following vacation I finished the preparatory and part of the Freshman work. The second year I finished the Freshman and about one-half of the Sophomore work. I then was allowed to enter the Junior year "conditioned," and by continued hard work during the remainder of the course I graduated creditably.

The $110 did not see me halfway through the first year, but I secured work about the college which more than paid my

tuition each year. I borrowed money at 6 per cent. interest from a friend to complete the course, giving him my note, with my father as security, and in order to protect my father from loss in event of my death, I took out a life insurance policy for $1,000.

I left college with my diploma and a debt of nearly $800. It was my desire to teach in a scientific or technical school, but being unable to secure a position, I resumed work as a machinist in a railroad shop, and was soon promoted to draftsman, and later to foreman. After holding the latter position for more than a year, the shops were abandoned, and I was obliged to begin again as a machinist in a locomotive works. After about two years I secured another foremanship in a railroad shop, and have since been promoted to general foreman.

I continued to do some studying along certain favorite lines in post-graduate work, and last June, five years after graduation, I received my Master's degree, had my debt all paid, and just $500 to my credit in the bank.

I am now thirty years of age. The last ten years have been years of constant sacrifice and hard and persistent struggle for the object of my ambition—an education. I am not yet married, probably for the reason that the time I might have spent in society was spent at my books. More than once I have been reminded that I have "cheated some good girl out of a home."

Now that the sacrifice has been made, I face the question: Did it pay? Only the coming years can decide. MECHANIC.

A Drill Jig Reconsidered.

Editor American Machinist:

The irregularly shaped piece, shown and described with its drill jig, by Mr. Woodworth, in issue No. 17, page 456, serves the purpose of illustrating every-day tool making so well that it is hoped no offence will be given by the criticisms and suggestions herein.

The conditions concerning these castings are not known, nor are their dimensions or the purpose they are to be used for—facts which render an attempted criticism open to error. It is assumed that the work is in sufficient quantity to warrant the construction of the tool; that a jig is designed and made for the purpose of saving time in laying out work to be drilled, for convenience in holding the work while drilling and to secure uniformity in the drilling. The more rapidly it can be made to operate, the greater the economy of its use. It must be so arranged as to hold each individual piece rigidly, so that it may not be moved by the pressure of the drill against it; uniformly, with respect to the location of the holes to be drilled, and in such manner that the piece cannot be distorted by the methods of clamping used. These are the common requirements, yet apparently they are not all fulfilled in the jig shown.

Although it is stated that the castings reproduced in Fig. 1, are of uniform size, it is not in ordinary experience to find rough castings, especially of such shape and section as shown, to have sufficient uniformity to warrant their being drilled from some fixed point on their edge and expect to obtain accurate results in the location of the holes with respect to centering up with the bosses or hubs shown.

The location of the machined edge *C* against a prepared seat in the jig is correct in principle, but the seat should be exposed to view and ready of access for the purpose of removing any chips or dirt likely to accumulate. It is suggested that stop-pins might have been used and the expense of planing saved.

Forcing the piece against a pin at one side, and that a rough side, is questionable practice; an equalizing device might be applied in place of the permanent stop *I* and set-screw *J* at very little more expense which would locate the work positively central notwithstanding any slight variations in the castings and hold them with equal firmness.

Again, from the illustration, it would appear that the stop-pin and screw point

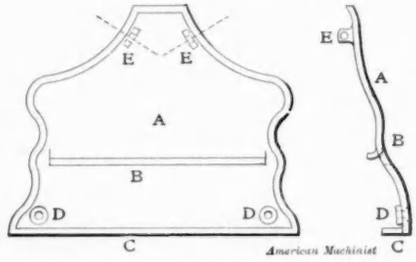


FIG. 1. THE CASTING TO BE DRILLED.

would keep the work *from* its seat by conjointly impinging on projections of the casting in such manner as to raise it from its seat. This may be the fault of the sketch, as may also the fact that the casting of the jig frame is shown to extend slightly below the feet *D* so that they could not rest upon the drill press table.

It is also a matter of doubt whether or not this jig would stand at all on the feet *C C* as the center of gravity of the tool is so far to one side of a central line through the drilling, when so positioned, that the equilibrium seems uncertain.

Making the sides at right angles with the base would simplify and lighten the construction materially, and the use of a V-block or angle plate would give a firm support at either angle.

The drill bushings *H* and *N* should *not* be driven in, but carefully pressed in, after being lapped to suit the size of the drill and ground to fit the holes prepared for them.

But a more serious objection is made to the method of supporting the work. The shape of the piece seems to lend itself readily to a three-point support, and experience has fully demonstrated that no matter how rough or irregular in shape a piece may be, it will touch upon three points, while the chances are a thousand to one if it would rest upon four without springing it. Comment is not necessary, as it is evident that work, if drilled while sprung, when freed and in normal condition, will have the holes therein any way but uniform. Further, three screws and lock-nuts cost less than four; but if from the shape of the piece it is decided that four or more support points are required the extra ones may be made adjustable by a screw, or, better yet, a spring pin may be used, which will automatically adjust itself and is then susceptible of being rapidly yet rigidly secured.

In Fig. 2 the idea shown may not be the best for the purpose—that depends upon conditions unknown; neither is it assumed that there are not many other ways for producing the same results, but it is believed that the principles of automatic location, irrespective of slight irregularities in size and contour, of support without distortion and of rapidity in changing work are worthy of consideration.

The support points are at *O* in the rear, two long pins on which the work may be rested when first introduced and slid back into position against the stop-screws *S*. These screws are adjustable, a binder screw, in the same hole, taking the place of the usual check nuts. The front support *P* is made adjustable, but is located in such a position that a check nut is preferably used because it is more readily accessible. The body of the jig has upon it all the feet, three on the bottom, four at either angle. The guides for the sliding plungers, the bearings for the locating levers, two of the drill bushings and all the stops are located in it. The bridge is a regular rectangle, the lugs carrying the clamp lever being a part of it or separate ears may be used.

In operation the work is dropped in on the pins and allowed to rest on the front support. Turning the knurled screw *W* first moves the lever *X* up against the casting, pushing it back against the stop-screws *S*. Continued turning moves the plunger *Y* back, the screw point abutting against it, and the lever *X* now acting as a nut only. Plunger *Y* has an angular or wedge-shaped end opposite the screw, which, acting against the plungers *Z* and *Z1*, moves them equally apart and in straight line, being guided by their bearings in the frame. These plungers in turn press against the lower end of the side locating levers *L* and *L1*, causing them to swing on their pivotal bearings and their upper ends to move positively, equally and uniformly towards the center of the jig, carrying the work until further forward movement is arrested by bringing up rigidly on the casting, holding it securely, in connection with the front lever, in every direction.

The clamp lever *T* has a strap spring which makes contact with the upper surface of the casting, it being adjusted to

give the desired pressure once for all. It may be noticed that it has a wiping action, tending to locate the work against the stop-screws. It should be brought down partially at the commencement of clamping a new piece of work, then the screw used and finally the lever be carried all the way down. In releasing work, loosen the screw first, the locating levers being moved away from the work by helical springs—not shown in the illustration—then the reverse movement of the clamp lever will bring the work forward ready to be picked out. W. E. WILLIS.

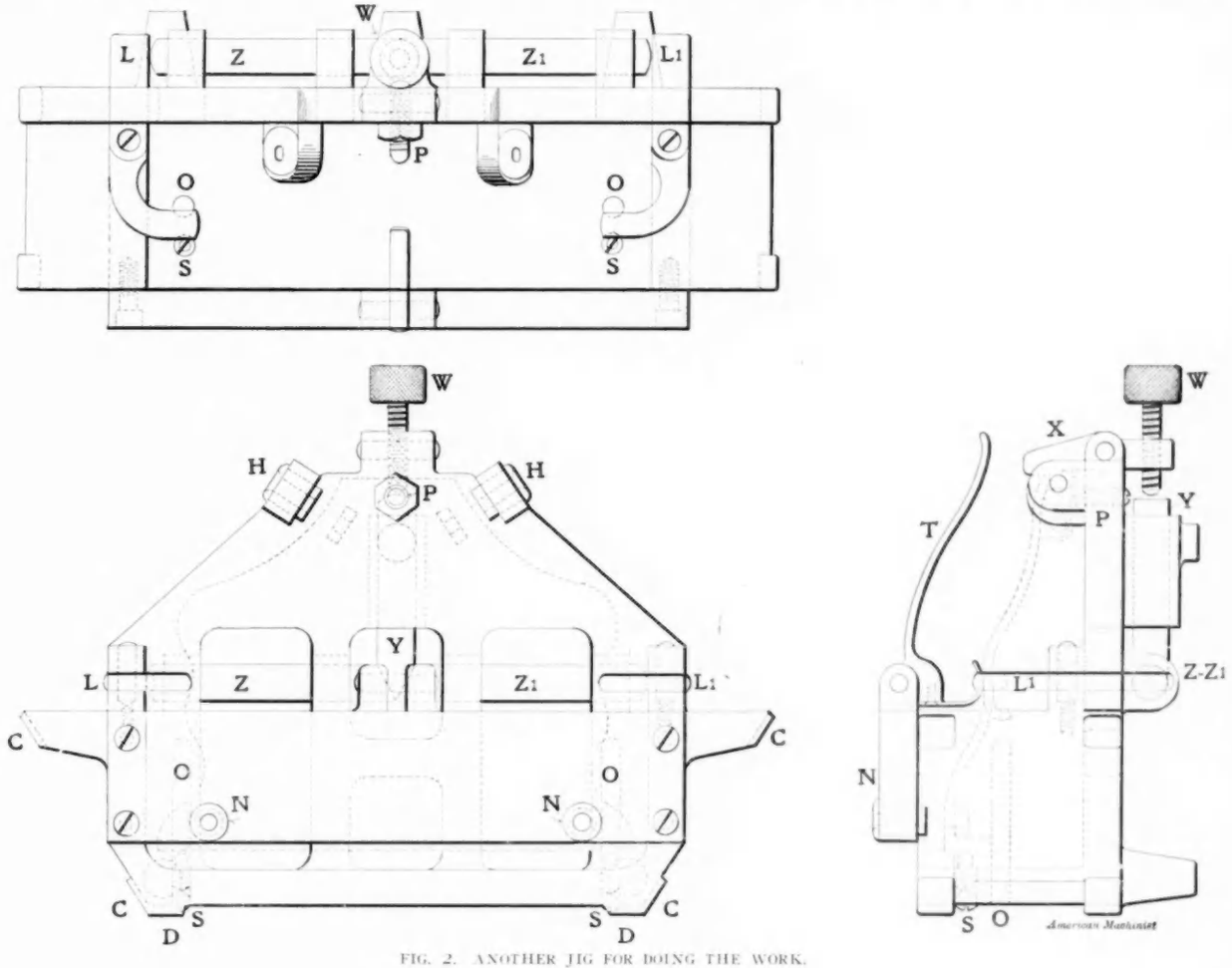


FIG. 2. ANOTHER JIG FOR DOING THE WORK.

Interesting Pump Experience.

Editor American Machinist:

We were opening a new mine out in the woods; had been working all summer (and in that country all summer is not very long) sinking a shaft and cutting a drift to drain an open cut mine. By the first of October a shaft 10 feet square had been sunk 70 feet. The drift running into the ore deposit was 500 feet long, with a shaft 6 feet square for drawing the open workings running down to the drift. Bad weather set in early in October, and we had about concluded to abandon the work until the following spring, when we were visited by a heavy rainstorm, swamping the pump and filling the workings full to their surface. We were completely drowned out. When spring came round, the situation was just the reverse of what it should have been; that is, the pump should have been on the surface ready to swing over the shaft and to lower as the water was pumped out instead of being at the bottom. We could have procured another pump and used it to clear the shaft, but this would have caused considerable loss of time and the purchase of a pump. Before doing this we concluded to try to make the pump at the bottom of the shaft pump itself out. The pump had kept on running in the fall as long as we could supply the steam. In fact, it was covered by fully 10 feet of water before it ceased working.

We had a portable boiler nearby which had been used for running steam drills. This we moved into the shaft house and coupled to the one already there, giving about double the steam capacity we had before. With plenty of dry wood to keep up the steam pressure we hoped to start the pump under the 60 feet of water. The steam pipe was 3 inches in diameter and was supplied with a valve close to the boiler. The valve at the pump was wide open when it had stopped. We broke the elbow at the top of the shaft and put in a tee with one opening upward. Through this opening we poured about 5 gallons of heavy lubricating oil in a body on top of the water. The 5 gallons we expected would be sufficient to coat the pipe and also lubricate the working parts of the pump and prevent the steam from coming in direct contact with the water. When a steam pressure of 80 pounds showed on gage we opened the valve, letting the steam against the oil, hoping to force the water down and out of the steam cylinder through the exhaust. The first attempt was a failure. We closed the valve and raised the steam pressure to 100 pounds. This time the water commenced to flow out of the exhaust pipe and very soon out of the discharge. The pump had started and it continued to run until the shaft was clear of water.

Here is another case where a steam pump continued to run until overcome by conditions over which it had no control. We were sinking a shaft, or what a Cornish miner calls a "sump." This shaft was at the bottom of an open cut 80 feet deep. One side of this cut was vertical rock, the other sloped back at an angle of about 60 degrees. The discharge pipe from the pump ran obliquely up this slope. The pump was a small one, with a 4-inch discharge. This pipe was not protected in any way from the cold. The work was being done in winter and was kept going

day and night. I was called out of bed about 5 o'clock one morning, when the thermometer registered 35 degrees below zero, and had to drive four miles to see what was wrong with the pump. It would not run, had gradually slowed down, and at last stopped without apparent cause. When steam was turned on the pistons moved very slowly and the joints about the water cylinder and also the piston packing leaked, showing that there was a lack of vent. I tried to open the valve, placed in the discharge pipe for the purpose of draining it and found it frozen. Following up this clue, I found the discharge pipe solid from end to end. The man in charge of the pump declared most positively that she had not been stopped at all during the night until she stopped herself. I did not believe him. We had to run another line of pipe, as it was impossible to thaw out the frozen line quick enough. Besides, it had bursted in several places.

The following night was fully as cold, and I decided to stay with the job all night and see that the pump did not stop and allow the water to freeze in the pipes. All went well until along after midnight, when the pump began to slow down. We examined the end of the discharge pipe and found the opening reduced to less than two inches. In fact, the pipe was gradually filling with ice and in a short time would be completely closed. I was convinced the thing was freezing up while the pump was running, and, if not drained at once, we would have still another line to run. We immediately opened the drain valve at the pump, letting out what water remained unfrozen. We then drilled a half-inch pipe hole in the elbow of the steam pipe, ran a line of pipe to the discharge and turned the steam in, thus melting out the ice. After starting the pump again we kept the half-inch steam valve partly open, thus raising the temperature of the water a few degrees and preventing any further trouble. B. W. T.

A Large Counterbore and Facing Tool.

Editor American Machinist:

Some years ago, when I began to read the "American Machinist," there were, and still are, many illustrated articles on small tools, and at that time I thought that they were a little out of place in the paper, but later on I changed my mind to such an extent that the first things I look for now are the small articles, for I believe there is more knowledge in them than the larger ones.

In the accompanying sketches I have tried to show the reader a useful tool. In 1897 I was head foreman of a large department where we manufactured steam engines, grinding machinery, 12-inch guns and a large variety of special work, and we had a large lot of hubs of almost every description to square up, and it required a large number of counterbores to do the work, and it was quite an expense to keep making the old style and keep the ends or squared surfaces straight enough to pass inspection. Fig. 1 shows a cast-iron body having slots for the adjustable blades. The blades are held by set-screws, one to each blade being sufficient to hold for all work that the cutter can do. The body part *a* is not so thick as body part *b*, which is made a little thicker than *a* to give the set-screw a longer bearing in the threads at *c*. Hole *d* is for a wrench to screw the tool on or off the spindle. The blades are made of the best tool steel, with a small bevel on the front side, so that the set-screw will have a tendency to force the blade down to the bottom and to make sure it will come straight on the cutting face, provided it is ground straight. The blades can be made of almost any shape on the cutting face. I have used them for rounding the corners of pulleys when they were chucked in the chucking machine and squared off on the hubs. The cutter shown in Fig. 2 can be cut out at *a* to increase the size of the tit and still leave enough of the cutter in the body for the set-screw to hold it securely. The cutters can be longer or shorter, to suit the work. I have used cutters as large as 8 inches diameter in facing up hubs, and found them to be sufficiently strong. For holes which are larger than the body the tool can be used as a boring tool, and will bore a first-class hole. The body can be fitted to any kind of a shank to suit the machine. The tapped hole *e*, Fig. 1, is used for a screw to hold the tit so it will neither drop out nor turn around. The tit, Fig. 3, can be made at *a* and *b* to suit the work. The diameter *a* I make about .005 inch smaller than the hole, and the length *b* about ½ inch, as they work the best at those dimensions. The shank part of the tit is recessed as shown, to receive the point of the set-screw. The recess keeps it from getting burred and it can be removed easily. The grinding holder, Fig. 4, is made of cast iron, chucked out at *a*, planed at *b* on an arbor in the centers, and then planed on the top side on the table,

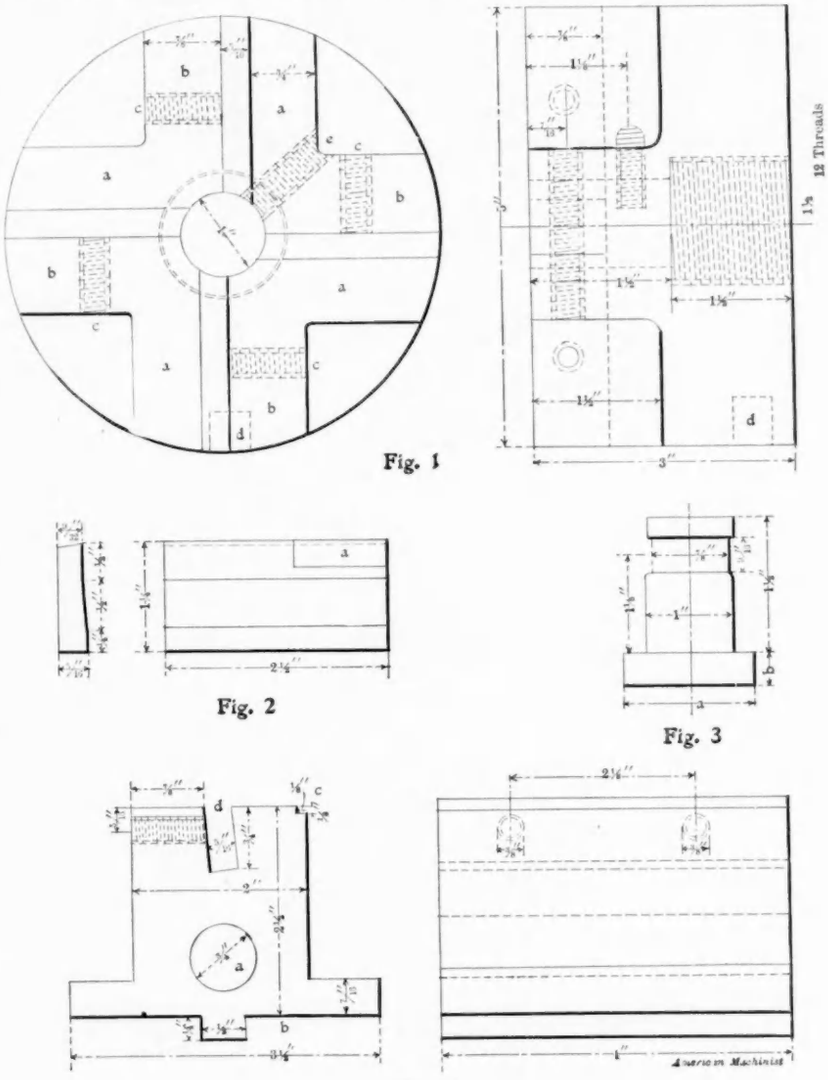


Fig. 1

Fig. 2

Fig. 3

Fig. 4

A LARGE COUNTERBORE AND FACING TOOL.

and it makes a very nice holder. It may be used on a surface grinder or in a universal cutter grinder. After putting the holder on the arbor at *a*, let it swing over until the part *c* comes down on the stop, the same as in grinding milling cutters, and proceed the same as in other work. The slot *d* is made at any angle that suits the maker, but I make it about 5 degrees. The screws for all parts I made of tool steel, with a good round point on the end, and they will last a long time. If a large number of pieces are to be squared up and a good surface is wanted, a roughing cutter is necessary. Consequently, I made another holder, as in Fig. 1, but made the cutters with saw teeth, and they work to perfection, one cutter being made so the teeth will cut off what the other has left.

WARREN A. WATERMAN.

Providence, R. I.

being in sixteenths, and the half-size in thirty-seconds (actual), giving sixteen spaces per inch. The edges *A* and *C* are in half-size, *A* reading, as shown, from right to left; and on turning the scale over, not end for end, we find *C* reading from left to right. The same applies to *B* and *D*.

The graduations and spacing were so arranged on account of possible errors in misreading where a double set of inch figures are used, one over the other. This error is very possible in readings made near the middle of the half-size scale, as taking 11 for 13, or *vice versa*. The open spacing of sixteenths on the full size are more easy for reading and better suited to the eye than the finer graduations. The scale is almost equally convenient for use as fourth or eighth size.

As a general rule, detail drawings are made to scale of one-half or one-quarter size, the one-eighth scale being only occasionally used. There are some drawing offices—perhaps only a few—where the purpose seems to be to utilize all the surface of the drawing paper, and therefore the scale of the drawing is made accordingly. Very recently a draftsman asked me if I had a scale of 2½ inches per foot, as he wanted to use it on a blueprint of a drawing sent here, which had been made to such a scale. I could only advise him to make a scale on stiff paper for his purpose. Since then I have learned that this is only one of many such odd scales which are allowed in their drawing-office practice.

I have found the scales in Figs. 1 and 2 all sufficient for any work that I can think of. The scale in Fig. 2, being a stock scale, can be purchased of any drawing instrument dealer. It also has the double bevel edge, and can be had in wood with white edges, or wood only, the latter being quite good enough for a scale to be used occasionally for such drawings as propo als and foundation display drawings. This scale is graduated to ⅜, ¾, 1½ and 3 inches per foot, as shown on sides *A* and *B*, and on sides *C* and *D* are graduations of ⅛, ¼, ½ and 1 inch per foot.

My experience with this and the triangular form of scale makes me in favor of the former as the most convenient to handle and to read dimensions from.

Hamilton, Ohio. WM. PILTON.

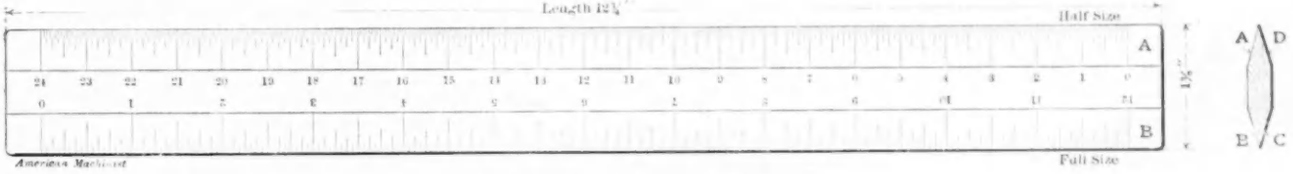


FIG. 1. HANDY SCALE FOR DRAFTSMEN.

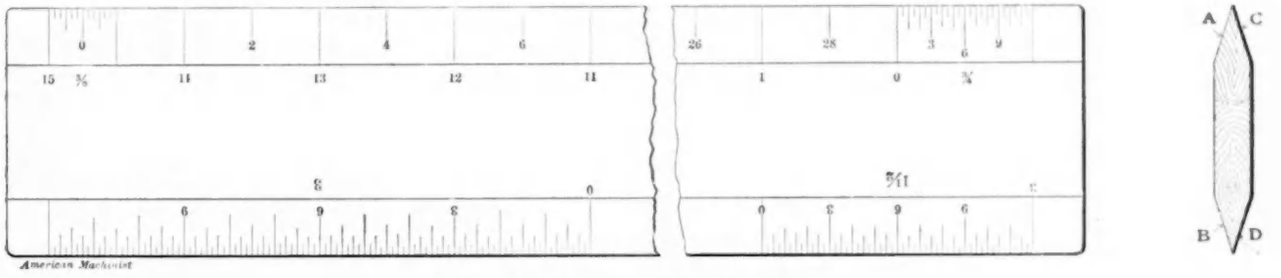


FIG. 2. HANDY SCALE FOR DRAFTSMEN.

Another Handy Scale for Draftsmen.

Editor American Machinist:

I send you blueprint of a handy scale for draftsmen, which I devised several years ago, a few other draftsmen and myself placing a first order for them. Subsequent orders have been placed with Theo. Alteneder & Sons, also the F. W. Weber Company, of Philadelphia. It has proved a very satisfactory scale with all who have used it.

Draftsmen have their several objections to the scales available in the trade stock, and no doubt there are numerous "handy scales" devised and in use. The scale here shown is made of the double bevel edge section with white facing for the graduations. Made in this way the white facings are strengthened and do not break or chip away as in the usual scale with sharp and weak edge. The scale is also free from the tendency to warp. Those who have used them daily for years find that they show but very little wear.

The four edges *A*, *B*, *C*, *D*, Fig. 1, are graduated from end to end, the full size

A Way to Blow Off a Boiler.

Editor American Machinist:

I was quite interested in the article on page 517, from St. Johns, N. B., about lubricating an engine with water. Either the water contains more lubricating properties than I have ever seen or we engineers have been asleep all these years. It might be like the story of an engineer telling how to keep boilers clean. The plant he was running consisted of a 25 horse-power engine and 50 horse-power boiler, and they were using a compound for the boiler that caused it to foam badly. His practice was in the morning when the steam was down to put in a quantity of the compound, then start a quick fire, causing the boiler to foam, then to raise the safety valve and blow the mud out that way. That might be a good way to clean boilers, but I prefer to use the blow-off, a hose, and plenty of elbow-grease. FRANK BULLIS.

A Boring Cutter not Fastened on the Bar.

Editor American Machinist:

A friend told me that he is using a cutter which is fitted loosely in the boring bar when taking a finishing cut. The cutter is the full length, same as the diameter of the required hole, and fits freely into the common rectangular slot of the car, ground for cutting on both ends of course. As I never saw or read of this arrangement, it might be new to some other readers, too. Holes from 2 to 6 inches will answer for this purpose the best. E. K.

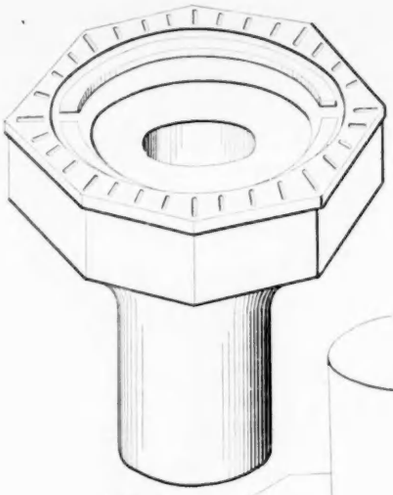


Fig. 1

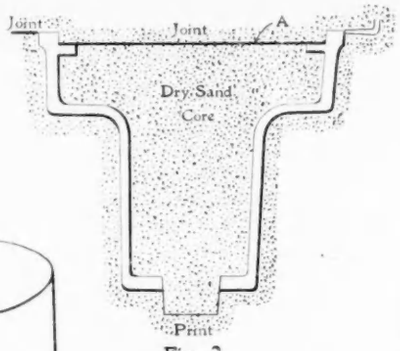


Fig. 2

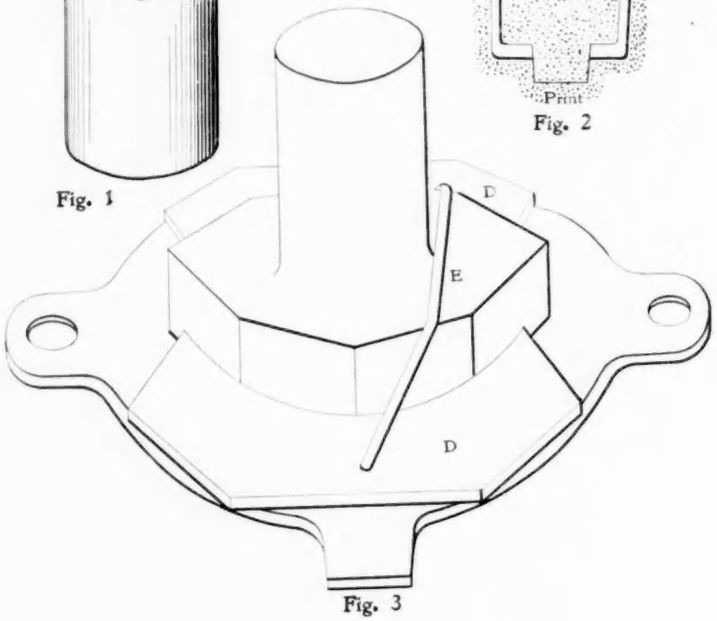


Fig. 3

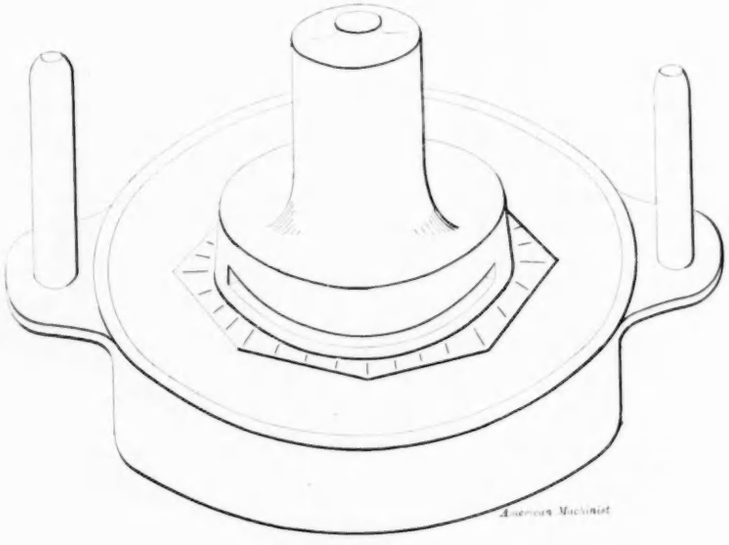


Fig. 4

MAKING A SMALL CASTING WITH GREEN SAND CORE.

Making a Small Casting With Green Sand Core.

Editor American Machinist:

Fig. 1 shows a small casting which was molded as in Fig. 2 with a dry-sand core. As several gross of these castings were required, the coremaking was a considerable item, and time had to be spent in fitting the joint *A* where core and mold meet. To overcome both the core and the joint troubles, an iron core-box was made with a plate for the joint of the mold attached, and also pin-holes to set the drag to, as in Fig. 3. The two loose pieces *D D* were secured in position by a small clamp *E*, and after ramming up the drag and turning over, the clamp was removed, the two loose pieces were drawn out and the core-box tapped off, the pins acting as guides. Fig. 4 shows the drag with green sand core. The cope was worked with a plate to form the joint, and pins to draw the pattern by as in the drag. The output of castings was doubled, the coremaking was done away with, and a very considerable saving was effected in the fitting shop.

GEORGE BUCHANAN.

Wrexham, North Wales.

A Terrible Pattern Shop.

Editor American Machinist:

I was just out of my time as a patternmaker in a not ideal pattern shop, but which was as good as the general run. I knew I needed the experience of other shops, and I made up my mind to go as soon as a place was open. It was not long before I heard of a place, and I wrote and received a telegram to come at once. The works had a good trade in pumping machinery.

I was taken to the room of which I should have full possession. The superintendent made a few excuses concerning the shop, but thought I would like it when I became accustomed to it.

To get to the room was by a stair on the outside, under the eaves, which had no gutters. The door to the pattern shop had no lock, and when I spoke of this they said everything was safe. As I thought a great deal of my tools, I could not feel safe at any rate. The room was about 12x14 feet, with low ceiling and blackened walls. If the windows had had blinds it would have been impossible to work. The room was lighted and heated by three jets of natural gas, one jet for light, one for heat, and the other the glue pot hung over. The gas pressure was strong enough so that one-quarter turn of the valve gave light and a half-turn, or wide open, gave a blue flame for heat. Below were the core ovens and the blacksmith shop, and as the floor was loose I had the benefit of the heat and smoke.

There were an old bench, about 2 inches too high, and a worn-out vise with a wooden screw. The tools consisted of lathe, band-saw and trimmer. The lathe had a wooden bed with wooden cone pulleys which were not true, and the bearings badly worn, so when on high speed you could imagine an earthquake. The band-saw was small, 24-inch band wheels with stationary table, and I was told it could not be used, as it broke the saw as fast as it was mended, only having the one saw. The trimmer was praised very highly by the superintendent, and he gave me instructions as to using it; and had I not seen the inside of other pattern shops, I might have thought it was the only one. It was rusty on account of the roof leaking.

I ground my tools in the blacksmith shop. If a board was wanted of any other thickness that that which was in stock—which was never more than three boards

while I was there—it had to be ordered from the planing mill, quite a distance away.

I soon made up my mind that this was not the experience I was looking for, and that it was going backward instead of forward. I also learned that the man whose place I took had been discharged on account of his habits, and no wonder, as it would drive the best to drink. So I gave it up before it came to that.

Richmond, Ind. BERT RUSSELL.

Making Erasures on Tracings.

Editor American Machinist:

The most successful plan that I know of for making erasures on tracings and then obliterating the effects of the erasure, is first to use an ink eraser—taking out the lines thoroughly—and then rubbing the tracing with powdered pumice stone. For this I use a piece of chamois skin, first sprinkling the cloth with the powdered stone and then rubbing thoroughly with the skin—afterwards blowing off the stone and polishing with the skin alone. I enclose a piece of cloth from which erasures have been made and which has then been treated in this way. C. A. TERRY.

[Mr. Terry's results are better than anything else of the kind we have ever seen. The gloss of the cloth is renewed so perfectly that only by the sharpest scrutiny can the fact that an erasure has been made be detected. It would pass ordinary inspection without the erasure being noticed. Our draftsmen readers should not let this pass without trial.—Ed.]

The Water Anneal.

Editor American Machinist:

In your issue No. 21 is printed a letter on "Water Annealing" by Mr. Charles H. Reynolds. I should like to add a little to Mr. Reynolds' remarks.

Water annealing is, strictly speaking, a *hardening* and *not* an annealing process. Tool steel when heated to any heat and cooled suddenly is hardened, the amount of hardness given to the steel depending on the temperature from which and the quickness with which it is cooled. Now, a piece of tool steel, as it comes into the shop, generally has considerable hardness, this hardness being due to working the steel under the hammer or in the rolls at a low temperature when finishing it. If this steel be "water annealed"—that is, uniformly heated until it just shows a very dull red color when held in a dark place, and then plunged into water—it will be somewhat softer and in better condition to work than the untreated bar. It will not, however, be as soft as if it had been cooled *slowly* from this same heat, and not nearly as soft as if properly annealed by the ordinary process of heating to a full "hardening heat" and allowing to cool as slowly as possible.

This subject is gone into very fully by Mr. Wm. Metcalf in his book on "Steel," which contains much valuable information along these lines. JOHN L. BACON.

Lewis Institute, Chicago.

Echoes From the Oil Country.

AMONG THE PUMPS.

A man who has never had any fun with a direct-acting steam pump, or had one of them have fun with him, has not had all the variety there is in life. Almost any one of these pumps can do more different things, and do the same thing in more different ways, than any other piece of machinery I ever ran across. If a man's head swells up so that he begins to think he knows it all, it can furnish the experience that will help to reduce it.

When I thought I knew most of the tricks I was called out to fix one. It was a little, insignificant fellow, used for pumping oil from a well tank up into the main receiving tank. We had repaired it, tested it and sent it out in first-rate shape, and it had done very well for a couple of months. It was a "Niagara," which was considered a very good make of pump.

Brown, the lease boss, came in in a hurry. "Say, Osborne, come right up with me," he shouted; "that blasted little pump has balked, and the tank is full and the oil's running on the ground. You must have left something loose in her when you put her together. We want to get up there as quick as we can, for if the old man gets up there and finds oil on the ground he will raise Cain. I did everything I could to the little rip, but still she won't go. Come on, now; hurry up."

Brown was evidently in a hurry, and that pump was about 400 feet higher up than we were, and the day was very warm.

I went up with him, and to see how she was, I turned on the steam. The pump started right away and took hold of the oil in good shape. After relieving the pressing necessities of the tank, Brown insisted that I tear things apart and see if everything was all right. This I did without finding anything in the least out of the way, and so I put things together and started it up and returned to the shop.

Brown was there almost as soon as I was and reported things at a standstill. I climbed the hill again, turned on steam and the pump started as before. Brown did some very emphatic cussing and acted as though he wished it hadn't. Again I tore everything apart and did not find any trouble, and when assembled she started as before. I began to question Brown about the source and quantity of his whiskey, but he declared he had sworn off months before.

I started down the hill and had gotten about an eighth of a mile, when I heard a yell, and, looking around, I saw Brown waving his arms for me to return. I climbed the hill again and I found the pump standing still with full head of steam on. I turned the steam off and then on again and away she went, and she ran for perhaps ten minutes and stopped. As soon as the steam was turned off and on again she started again. Several times this was repeated. While she was running I tried to figure it out, but I couldn't think of any reason that fitted the case.

Brown said it must be the way we had fixed her at the shop that was doing the mischief and I must fix it. I was willing enough to fix it, if I could only know what to fix. It couldn't be in the steam supply, as there was a good head right at the pump; nor the exhaust pipe, as that was not over 3 feet long. You see, this thing sat on a log out in the open air.

Again I tore things apart, examining each part thoroughly, but I found nothing out of place. I took the main valve (which was a combination of piston and flat valve) apart and examined all the small port holes and found them open, and also those in the cylinder. I tried to think of some theory of unequal expansion that would cover the case, and I almost wished I had sent up one of the boys instead of coming myself.

Not knowing what else to do, I put things together again and started up. Suddenly she stopped short—not one of those slow stops they sometimes have, as though they were being choked to death, but just a stop without a pound. I took off the steam-chest cover and began another search, and this time I found something. Down in one of the little auxiliary ports a little scale covered the hole that runs to the piston valve. I touched it with my scriber and it dropped over to the bottom of the hole, and seemed part of the solid pump.

I called Brown and had him look into the hole, using a piece of tin to throw the light into it (it was not over 5/8 inch deep). He declared it was empty and clean, and so it certainly seemed.

By a little effort I raised the scale up to its former position and it filled the hole leading to the valve to a nicety, and was just balanced so that a jar easily made it drop back into the bottom of the port again. It looked like a thick scale from the steam pipe, but it could not have done better what it was doing if it had been made for the place purposely. It is needless to add that its removal allowed me to stay down the hill for the rest of the day when I got there.

Another pump was equally puzzling, but it lacked the scale. It was at an oil refinery, and was a blower pump used to blow the acid to treat the oil. The acid was in the oil in the agitator, and the pump wouldn't furnish wind enough to do the trick to the treater's mind, and an emergency call was sent for me.

I got there and found the pump limping along, lop-sided. It was impossible to get

half speed out of it. This was a differently made pump from the other and quite a decent sized one. It had a piston valve about 4 inches in diameter that was used to throw the flat valve. This piston valve has a small hole through the center on each end, through which the steam blows. An auxiliary valve exhausts this, from first one end and then the other, letting the valve be thrown by the pressure on the end not exhausted.

I found a nail driven into one end of the valve, stopping the hole. Here was my trouble, no doubt; so I knocked the nail out and tried to start. The pump ran lop-sided as before, but now it was the other side. Well, that was simple enough; the valves leaked a little and needed scraping, so I scraped them and I found the pump ran a trifle worse. I scraped some more and put the valves into as perfect shape as I knew how and the pump barely kept going.

The treater in the meantime stood around with tears in his eyes, wishing he had let well enough alone, and insisting that it was a mistake to take out the nail.

In despair and disgust, I took off the valve-chest head and drove a nail in. Now the pump would only run by being struck vigorously with a hammer for every stroke. I took the nail out and put it into the other end and the pump refused to move for any amount of hammering.

To hide his grief and despair the treater left the building.

I will explain that this pump sat in a room with several others, that its nearest neighbor was a benzine pump, and that the fumes of gasoline were so strong that any artificial light was suicide. Electric lights had not gotten to the refineries. I began a careful hunt over the valve motion, and I was prodding around the small ports with the points of my inside calipers when they caught in a hole that I never remembered being there. I found a piece of looking-glass tacked to the wall and, using it as a reflector, I found that the hole drilled in making the port had pricked through into the exhaust. That explained how the nail had balanced things. A little piece off a lead pipe closed the extra hole, and I got the steam chest back in place just as the treater returned.

I told him everything was O. K. except that nail and turned on the steam. She ran quite well, but was quick on one side and slow on the other. I stopped to take the nail out, much against the treater's wishes, as he evidently wanted to let well enough alone this time. When the nail was removed, everything went lovely, and when she was speeded up to her best gait, the treater grew quite cheerful, and he said she was better than when she was new.

W. OSBORNE.

A Bolt Head Scale.

Mr. D. J. Kelsey, of New Haven, Conn., whose appliances for draftsmen's use we have had occasion to notice from time to time, has published a useful card of circles from 1-16 to 1 inch in diameter, varying by sixteenths, each circle having struck from its center an arc of the circle inscribed in standard United States hexagon nuts and cap screw heads of the same nominal sizes with a portion of the hexagon heads and one corner of square set-screw heads.

The idea is that the sight of the actual circles is an aid in deciding on the sizes of bolts, etc., to use in designing, while the radii of the inscribed circles of the bolt heads and nuts can be taken directly from the card by the dividers.

The Mathematics and the Eagle Eye of the Driller.

The following from "The Cincinnati Post" is kindly sent in simultaneously by more than one of our correspondents. It is to be hoped that the lathe hand, the planer, the man at the vise and the other fellows will get as good a "write-up," and if they do there's no telling about the future:

"Among the various branches of the machinist's trade the drill worker takes the portions of a machine, one after the other, when the lathe worker and planer have completed their task of rounding, squaring, shaping, beveling, threading and boring. These partially prepared pieces must be finished by the drill press, and when sent from there to the vise worker must be in shape to fit perfectly into the finished machine. Although the drill worker has probably never been to college and very likely cannot describe the distinctions between geometry, trigonometry and differential calculus, yet he is required to be a practical expert in mathematics, and could probably daze a college professor with his practical application of geometrical principles. The drill worker takes the drawings and plans of the machine which is being constructed, as well as the many pieces of the machine itself. He finds his centers, takes measurements, compares the partially finished pieces with the drawings submitted, and then makes every little portion of the machine the exact size and shape that is required. He must not miss any of his dimensions by a hair's breadth. The drill worker also operates the milling machine when necessary. This machine does all sorts of grooving and sawing and puts the finishing touches to the lathe and plane work. The very small pieces that go into the machine are worked on a special shaper by the drill man. To do his work the driller must of necessity have an eagle eye. His eye has to settle those problems correctly, and without the loss of a minute's time, as time is one of the most important factors in a machine shop. Every master machinist must be capable of doing the work in all the branches of his trade, and a study of what his duties are that he performs every work day shows why the machinist is invariably a bright, brainy man. The striking machinists claim that the time they spend in apprenticeship is equal to the time a professional man spends in college, and that if the latter deserves large fees for what he knows more than for what he does, they likewise deserve the raise they demand in the present strike."

Legal Notes.

POINTS ON THE LAW OF NEGLIGENCE FROM RECENT CASES.

The duty of qualifying an inexperienced employee for the performance of new and dangerous duties is a personal duty of the employer, who is responsible for the proper qualifications of any persons to whom it is delegated, and for their negligence in failing to continue the instruction until it is completed. (104 Fed. Rep. 124.)

An employer is not negligent in employing a workman who proves to be incompetent, where, prior to the act of the workman complained of, no incompetency was suggested or known to the employer, and all the workman's previous acts evinced care on his part. (47 Atl. Rep. 354.)

Where a workman, knowing that a machine is defective, fails to notify his employer, and without knowing that the employer has knowledge of its defective condition, operates the machine, and is injured by it, he cannot recover for such injuries from the employer. (28 So. Rep. 707.)

A superior of an employee has no authority to order the latter to commit any act the doing of which would naturally or necessarily be attended with great danger to life or limb, and obedience to such order under such circumstances is such negligence on the part of the employee as will defeat a recovery against his employer for his death. (1 C. L. R. 305.)

An employee is not chargeable with negligence unless the defect and danger by reason of which he is injured is obvious, or he has been advised of the failure of the employer to perform his duty, or of such facts as would cause a reasonably prudent man to investigate. (11 O. C. D. 87.)

Improvement of the Parcels Post System.

For some time past complaints have been lodged with the Treasury Department by importers in interior parts of the United States, as to the annoying delay caused by the present slow method of handling Parcels Post packages received at the Custom House in New York from Germany. The Secretary of the Treasury suggested to the Postmaster General that these delays might be avoided if the packages were placed in separate mail pouches before they left the foreign countries and thus were sent to their point of destina-

tion, where they could then be appraised for duty. The proposal met with an objection from the Postmaster General, who seems to see in it a possible loss of revenue, on the ground that the customs officials, outside of those at the ports of New York and Chicago, have not had a sufficiently wide experience to enable them to classify such imported articles correctly for the assessment of duty, and to this he adds minor objections. However, it is understood that Secretary Gage thinks these obstacles may be overcome, so it is likely that the matter will be taken up with the German postal authorities.

Improved parcels post systems are sorely needed by this country, both at home and abroad. England and Germany came to their senses in this respect many years ago. Before, however, we can secure much better facilities for sending merchandise through the mails a powerful factor of opposition will have to be overcome, for the reform cuts directly at the private transportation companies, who will lose business in proportion to its adoption, and who, if worst came to worst, might even have to make some reduction in their rates. Doubtless a remembrance of this fact will furnish an extra incentive to manufacturers and merchants who are tired of paying the present express charges, to lend their influence in support of the reform.

A concerted effort will be made to secure legislation for an adequate parcels post system in the United States, and the co-operation of the Post Office authorities will be sought for the extension of the system used in dealing with foreign countries. This movement is being promoted by Mahlon A. Winter, who presented a thesis upon it to Congress at the last session. He is ready to answer questions concerning it, and may be addressed at 359 Pennsylvania avenue, Washington, D. C.

What the Chemist Has Done for Iron.

In the matter of supplying the engineer with suitable constructive materials, the most striking case is that of the introduction of cheap steel of varying qualities in substitution for costly steel and other less suitable forms of iron. The original production of Bessemer steel from the pure Swedish cast iron was undoubtedly suggested by accurate chemical analyses which showed the relative chemical composition of cast iron, wrought iron, and steel. The process owed its original suggestion, as well as its salvation from failure, to the chemical knowledge which was supplied to those who were interested in the procedure. But it further owed the extension of its application to all the commonest, cheapest and most abundant kinds of impure English cast iron to the further utilization of chemical knowledge and suggestion, for Messrs. Thomas and Gilchrist proved that the British pig irons could be converted into good steel if they were treated by the Bessemer process in the presence of basic substances such as lime and magnesia, since under these circumstances their phosphorus was eliminated. At the present time the metallurgical chemist and the chemical metallurgist are engaged in furnishing metals and alloys, new to commerce, which can rank in importance with cheap steel, only in a somewhat minor degree; and the engineer in every department of his activity is now continually having placed at his disposal alloys which are more suitable for his various designs than any which he has hitherto employed.—Prof. Frank Clowes, Institution of Civil Engineers, London.

Laboratory Assistants in Physics Wanted.

The United States Civil Service Commission, Washington, D. C., announces that it is desired to establish an eligible register for the position of laboratory assistant in physics, National Bureau of Standards, Treasury Department, at $1,200 or $1,400 a year. It will not be necessary to appear at any place for examination. The examination will consist of the following subjects: Education and training, original investigations, experience, thesis. Age limit, twenty years or over. Persons who desire to compete should apply for application form 304 and special form, which should be executed and, with the material required, filed with the Commission prior to the hour of closing business on July 6.

A 4427-foot Cable Span.

A remarkable feat of mechanical engineering in connection with electrical work has been accomplished in California. The city of Oakland and many other points are to be supplied with current derived from Sierra Nevada mountain streams by the Bay Counties Power Company, and in order to bring the main line across the Carquinez straits, near Port Costa, a tower has been raised on each side. These towers will be 80 and 200 feet high respectively, and steel cables strung between with a 4,427-foot span—three times that of the Brooklyn Bridge. These cables are each ⅞ inch in diameter and composed of nineteen wires with a breaking strength of 200,000 pounds per square inch. A factor of safety of 4 is allowed them. They sag 224 feet from one tower and 146 feet from the other. The lowest point is 208 feet above high water. It is said that the cables swing or jar less on a windy day than on a quiet one, for which an attempted explanation is, that the wind acts as a buffer to prevent local vibration.

There are other interesting features to the Bay Counties Company's system. The power line reaches 140 miles, though current is taken off at varying distances to supply Sacramento, Vallejo, Napa and other towns as well as mining regions. From Vallejo a branch will extend to the government navy yard to furnish power for the shops and foundries. Three generating stations on the North Yuba and South Yuba will furnish 20,000 horsepower when all the available water is used. The most important of these three powerhouses is at Colgate, and began operation in September, 1899. The water is supplied from a flume 7 miles long, with a drop of 13 feet to the mile, and terminating on the hillside at a point 700 feet above the power-house, which it reaches through four 30-inch pipes, which are cast iron at the bottom and steel at the top. At another power plant the water is received under 300 feet head through a 42-inch pipe. The transmission wires are partly aluminum and partly copper, the lines from Suisun to Oakland being of copper wire only, because of the salt air and the fumes from the smelting works. The voltage of the long-distance line when first put in operation will be 40,000, but this may later be increased to 50,000 or even 60,000.

Ericsson's Insistent Precision.

He insisted upon the absolute letter of a contract or a specification, and woe unto him who endeavored to evade one, unsanctioned by him! So insistent was he upon this point that in at least one instance a ludicrous thing took place. It was customary in those days to get the length of a piston rod the last thing, after the other details were in place. In pursuit of this object a draftsman once went down into a cylinder with a long baton and had hardly got off the ladder which led down into it, when Captain Ericsson came on deck. Espying the draftsman, he said:

"What are you doing in my cylinder, Mr. Nelson?"

"I am getting the length of the piston rod, Captain Ericsson."

"Have you looked on the drawing, Mr. Nelson?"

"No, sir."

"Come right out of that cylinder, Mr. Nelson; I will not have people going down in my cylinders with sticks to measure. Go look on the drawing, sir, and you will find the length of the piston rod."

This point he always insisted upon—that his drawings were correct, and if they were followed no loss would ensue. A workman once told me that he had a connecting rod for a link motion to put up in which there were as many offsets as there are in a dog's leg, and that, try as he might, he could not get the rod in. He told Captain Ericsson of this and was asked if the rod was right according to the drawing. The man said that it was. "Then it will go in," was the reply, and after another trial it did go in.

For most of his devices he had models made to scale, showing the relative positions of the parts with accuracy. They

were finely finished and put together, and drawings were made for them exactly as they were to be constructed—woe unto the model maker if he did not make every detail according to the drawing. If a fillet was omitted, or square-head bolts put in where hexagon heads were indicated, the departure had to be rectified, no matter what it cost the model maker.—E. P. WATSON in "Engineering Magazine."

The Exacting Conditions of Repetition Work.

While speaking of standard designs and repetition work, I should like to express dissent from the view sometimes put forward: that the execution of work of this kind involves a lower class of engineering practice than the carrying out of a great variety of work. Those who hold this view have, I think, had little experience of what high-class repetition work really means. In the first place, the maker of a machine or engine which he turns out in large numbers must, to be successful, be quite free from anxiety as to the quality of any such machine when it leaves his factory. There must, in such a case, be no question of improvements or adjustments being effected after the article sold reaches the hands of the purchaser. One cannot conceive the makers of a sewing machine, or of a typewriter, having any anxiety as to the performance of any individual machine they may turn out; and the same should be the case with any machine tool or engine of standard type. This means, of course, a system of examination and testing of a vastly higher degree of efficiency and exactitude than was deemed necessary under the older methods of manufacture, and as a result the purchaser as well as the manufacturer gains greatly. Moreover, the inspection during manufacture must not be confined to the gaging of dimensions or accuracy of erection, but must extend to the quality of materials used. Where automatic machinery is employed, and every endeavor is made to get all the work possible out of a machine, irregularities in the character of the material operated upon, or in the quality of the tools used, are often disastrous; and thus a careful watch must be kept to avoid such variations.—Address of President WILLIAM H. MAW, Institution of Mechanical Engineers.

Managers of blast furnaces long ago noticed that in winter when the air is cold and dry they can make pig iron more cheaply than in summer, when the air is charged with moisture. An experiment is to be made toward supplying what may be called winter air to the furnaces at all times of the year. Preparations are being made by the United States Steel Corporation for a refrigerating plant which will deprive the air of most of its moisture before the blast is sent to the furnaces. The apparatus is to be installed at the Lucy furnaces of the Carnegie Company at an approximate cost of $100,000.

A course in drawing, designed especially to meet the requirements of teachers, has been prepared by the International Correspondence Schools, Scranton, Pa. Drawing is of considerable importance to teachers, a number of States requiring applicants for teachers' certificates to pass an examination in it, and it is probable that other teachers will do likewise. The Schools' drawing course will qualify teachers not only to pass such examinations, but to successfully fill positions as instructors in drawing.

One of the curious things connected with the Philippine tariff proposition is the objections that have been made by some American manufacturers to the use of the metric system by the Philippinos. They have been using the system there for many years, it seems, and these bright American manufacturers proposed to make them quit using it and take up our system, or rather the so-called system which we use, because they said that if the Philippinos went on using the metric system it would place American manufacturers at a disadvantage in the Philippines as compared with those of other nations. It is reported that the authorities will pay no attention to the demand.

The Michigan College of Mines has received from the present legislature the largest appropriation in its history. This provides among other things for two new buildings. One is for the departments of Civil and Mining Engineering. The amount allotted for its construction and equipment is $42,500. The other building is for the departments of Chemistry and Metallurgy, the appropriation being $35,000. Provision is also made for an addition to the present engineering building, which will take care of the needs of the course in blacksmithing, for extending the equipment of the electrical laboratory, and for enlarging the central heating plant.

At a late meeting of the Providence Association of Mechanical Engineers, Mr. Charles D. Rogers, who has been identified all his life with the manufacture of screws, gave the gimlet-pointed wood screw an antiquity not generally suspected. He said there was at Smith College, Northampton, a piano made in 1758, in which pointed screws were used. Tapered screws were made at Poughkeepsie about 1836. They worked loose, however, where there was much jarring. Mr. Rogers did not indicate where and when the pointed screw began to be manufactured on a commercial scale, except that when he was superintendent of the Utica Screw Company, which went out of existence in 1860, he altered the machinery by which the blunt screws were made because they were no longer salable. He gave the French the credit of first making screws by machinery and they began it in connection with the manufacture of clocks and watches.—"Journal of Commerce," New York.

Personal.

G. H. Gregory has been appointed master mechanic of the Columbian Paper Company's new plant at Bristol, Tenn.

President J. W. Duntley of the Chicago Pneumatic Tool Company, sailed for Europe, June 15, on the "Campania."

H. A. Higgins, the general manager of the Standard Tool Company, Cleveland, O., sailed for England May 15, to visit the foreign representatives of his company in England, France, Germany, Russia and Scandinavia.

Obituary.

Thomas Curtis Clarke, an engineer most eminent in bridge construction, died in New York city, June 15, seventy-three years old. Mr. Clarke was the senior partner of Clarke, Reeves & Co., afterwards the Phœnix Bridge Company, of Phœnixville, Pa. In 1884 he became one of the original members of the Union Bridge Company. Mr. Clarke had been concerned as responsible engineer in the construction of over eighty miles of bridges and viaducts, among which are the Kinzua Viaduct, the Poughkeepsie Bridge and the Hawkesbury Bridge in Australia.

It will be remembered that in our first issue in March, this year, Mr. Tecumseh Swift told of a curious sawmill which an old millionaire had been amusing himself by building. We regret to announce that the old gentleman is dead. He was Charles Hyde, of Plainfield, N. J. He was in his eightieth year, although Mr. Swift spoke of him as apparently about sixty. He was a native of Oil City, Pa., and oil having been struck upon his farm he became rich at once. He was president of three banks, owned a railroad in Georgia and a large estate at Plainfield, his total wealth being estimated at $10,000,000. His widow is a descendant of the astronomer Kepler.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 24.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

For Sale—New No. 0 Dey time register. Niles Tool Works. (See page 3.)

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Expert work in engineering and mechanical drawing. Address Kacler, care AM. MACH.

Wanted—6 ft. or 8 ft. boring mill, in good condition. Materne Mfg. Co., St. Louis, Mo.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J.L.Lucas, Bridgeport, Ct. Send for index sheet.

"Brandt's Triple Expansion Gaskets" are